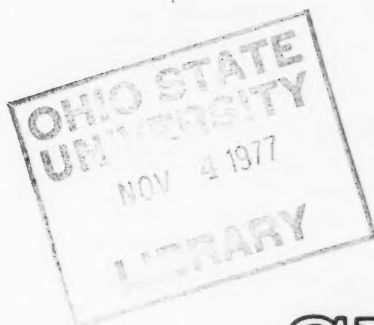


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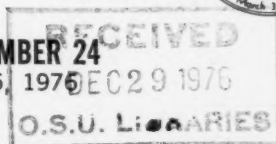
# SELECTED **WATER RESOURCES ABSTRACTS**



Deposited

**VOLUME 9, NUMBER 24**

DECEMBER 15, 1976



W76-12676 -- W76-13200  
CODEN: SWRABW

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# **SELECTED WATER RESOURCES ABSTRACTS**

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology,  
U.S. Department of the Interior



**VOLUME 9, NUMBER 24**  
DECEMBER 15, 1976

W76-12676 -- W76-13200

The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department.

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1978.

# SELECTED WATER RESOURCES ABSTRACTS

**A**s the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.



AS ORDERED BY THE SECRETARY OF THE INTERIOR

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## FOREWORD

**S**lected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center  
Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, DC 20240

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- 02 **WATER CYCLE**  
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.
- 03 **WATER SUPPLY AUGMENTATION AND CONSERVATION**  
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ABSTRACT SOURCES

# SELECTED WATER RESOURCES ABSTRACTS

## 2. WATER CYCLE

### 2A. General

**A MATHEMATICAL MODEL FOR FLOOD-WAVE FORECASTING BY MEANS OF WARNING BASINS,**  
Institutul de Meteorologie si Hidrologie,  
Bucharest (Romania).  
For primary bibliographic entry see Field 4A.  
W76-12829

**THE SIMPLIFIED INTEGRAL MATHEMATICAL MODEL ON A SMALL LOW-LAND CATCHMENT,**  
Technical Univ. of Warsaw (Poland). Inst. of Environmental Engineering.  
M. Ozga-Zielinska, and K. Krajewski.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 129-137, March 1976. 2 fig, 8 ref.

Descriptors: \*Mathematical models, Mathematics, \*Infiltration, \*Model studies, \*Evapotranspiration, \*Basins, Hydrology, Seasonal, Groundwater movement, Groundwater flow, Snowmelt, Surface runoff, Winter, Structures, Summer, \*Watersheds(Basins).  
Identifiers: Lumped-parameter model.

A model was developed for a small lowland catchment considered to be homogeneous and consequently allowing the adoption of a lumped-parameter model. It incorporated all the most important hydrological processes occurring in the catchment: evapotranspiration, infiltration, groundwater flow, surface runoff, and snowmelt. Each of these processes was modelled separately; the parameters expressing the given process in descriptive terms resulted from the effect of the optimization of the functions with a specific objective. Nonstationarity of the system was taken into account by dividing the year into two periods, a winter and a summer season. The conditions of the run of some hydrological processes were highly variable and, consequently, the process of infiltration and surface runoff had been identified separately for each period on two occasions. (Roberts-ISWS)  
W76-12831

**A MATHEMATICAL MODEL OF THE 'RESERVOIR' TYPE DESIGNED FOR FLOOD-WAVE MODELLING AND FORECASTING,**  
Institutul de Meteorologie si Hidrologie,  
Bucharest (Romania).  
P. Serban.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 139-147, March 1976. 3 fig, 3 tab, 4 ref.

Descriptors: \*Mathematical models, \*Reservoirs, \*Flood waves, \*Forecasting, \*Rainfall, Equations, Basins, Evaporation, Unit hydrographs, Evapotranspiration, Discharge(Water), Mathematical studies.  
Identifiers: \*Flood wave modelling, \*Derived model, Discharge conversion, Modulation function, Production function, Discharge hydrograph, Model parameters, Model implementation, Conversion.

A mathematical model was derived to achieve the rainfall/discharge conversion by means of two individual equations: a production function and a modulation function. Through the production function, the rainfall, P, over a basin was converted into effective rainfall, which became available for runoff. The conversion was achieved by means of a number of reservoirs, NS, each of which could store a maximum amount of water. The total range of reservoir numbers was a parameter that had to be optimized. A parameter defined as the maximum storage capacity of the soil was introduced. Evaporation, E, from the first

reservoir was taken as a potential value, and the evaporation of the second reservoir in the series was taken after the depletion of the first one and multiplied by a parameter CE, of value less than unity. When the second reservoir in turn became depleted, the rate of evaporation from the third one was taken as multiplied C(E squared), and so on. The potential evaporation was multiplied by a parameter RT and compared with rainfall. When the rainfall exceeded evaporation, runoff was supplied after seepage and reservoir capacity had been exceeded. The hydrograph of the effective rainfall was transformed into a duration discharge hydrograph by using a modulation unit hydrograph which was determined by the gamma distribution function. A continuous period of observations for at least five years was necessary. The observations included rainfall, evapotranspiration, and discharge estimates, excluding baseflow. (Roberts - ISWS)  
W76-12979

**AN ADAPTIVE IDENTIFICATION AND PREDICTION ALGORITHM FOR THE REAL-TIME FORECASTING OF HYDROLOGICAL TIME SERIES,**  
International Inst. for Applied Systems Analysis, Laxenburg (Austria).  
A. Szollosi-Nagy.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 163-176, March 1976. 7 fig, 2 tab, 24 ref.

Descriptors: \*Time series analysis, \*Algorithms, \*Forecasting, Hydrology, Equations, Mathematical studies, Stochastic processes, Computers, Water quality, Variability, Water resources development.  
Identifiers: \*Hydrological time series, \*Real-time forecasting, Data window, Noise variance, Variance, Recursive algorithms, Sequential prediction.

The state space formulation of hydrological/water resources systems was outlined. Prediction algorithms were proposed which satisfied the requirements of suitable prediction schemes by using time domain formulation. These avoided the usual frequency-domain based computations, and the problem became mathematically tractable. Due to the recursiveness of the algorithms, the scheme was easily implemented even for small computers and was applicable for real-time on-line forecasting. An example was presented using simulated data. The results indicated the practical applicability of the proposed procedure. The procedure could be extended to include the identification/prediction of stochastic nonlinear hydrological systems, by augmenting the state vector with the ordinates of the higher order impulse responses, and then taking advantage of nonlinear filtering techniques. (Roberts - ISWS)  
W76-12980

**DATA ANALYSIS AND SYSTEM MODELLING IN URBAN CATCHMENT AREAS (IN THE NEW TOWN OF LELYSTAD, THE NETHERLANDS),**  
IJsselmeerpolders Development Authority, Lelystad (Netherlands). Scientific Div.  
J. A. Van Den Berg.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 187-194, March 1976. 2 fig, 2 tab, 5 ref.

Descriptors: \*Data processing, \*Model studies, \*Probability, Urban runoff, Precipitation, Sewers, Subsurface drainage, Groundwater, Equations, On-site data collections, Rainfall, Persistence.  
Identifiers: \*Data analysis, \*Polders, \*Lelystad(The Netherlands), \*Zuiderzee, System modelling, Urban catchment areas, Sewer system, Probability distribution.

The new town of Lelystad, The Netherlands, had several catchment areas in its residential quarter, a parking lot, and the shopping and office center. These were located in recently reclaimed polders in the former Zuiderzee. Precipitation was the

input; the discharges were the rainwater sewer system, the subsurface drainage system, and the groundwater level. Precipitation and discharges were continuously measured and automatically recorded. The objective was to determine the probability distribution of the outputs from the distribution of the input and from the deterministic operations which could be represented by a matrix. From these data, rainfall and discharge intensities were calculated for the periods of observation. Persistence, or autocorrelation, existed between these intensities when dry spells were disregarded. The first step in the data analysis was a deterministic approach, using the principle of input-response-output. The responses were environmental, producing the transformation of the input. This was demonstrated by precipitation values and inflow into storm water drains, the latter generated from outflow measurements by a deterministic relation. (Roberts - ISWS)  
W76-12981

**METHODOLOGY FOR THE SELECTION AND APPLICATION OF PROBABILITY MODELS FOR THE SIMULATION OF DAILY RAINFALL AND RUNOFF,**  
Purdue Univ., West Lafayette, Ind. School of Civil Engineering.  
For primary bibliographic entry see Field 7A.  
W76-12994

**GROUND WATER MOVEMENT,**  
National Water Well Association, Worthington, Ohio.  
For primary bibliographic entry see Field 4B.  
W76-13031

**FINITE-DIFFERENCE MODEL FOR AQUIFER SIMULATION IN TWO DIMENSIONS WITH RESULTS OF NUMERICAL EXPERIMENTS,**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 2F.  
W76-13085

**GEOMORPHOLOGY AND CLIMATOLOGY OF ARID WATERSHEDS,**  
Hebrew Univ., Jerusalem (Israel). Dept. of Geography.  
A. P. Schick, and D. Sharon.  
Hebrew University, Department of Geography, Final Bi-Annual Technical Report, September 1974. 162 p, 35 tab, 19 fig, 2 append.

Descriptors: \*Geomorphology, \*Climatology, \*Watersheds(Basins), \*Arid lands, \*Terrain analysis, \*Rainfall, Floods, Rainfall disposition, Rainfall intensity, Rainfall-runoff relationships, Bed load, Streamflow, Alluvial fans, Deposition(Sediments), Erosion, Hydrograph analysis.  
Identifiers: Nahal Yael Research Watershed(Israel).

Environmental data have been collected and analyzed at the Nahal Yael Research Watershed in the Negev, Israel. The study of non-uniform fields associated with local convective processes was stressed in rainfall analysis. Records from a dense network were used to identify rain-producing cells along pre-frontal convergence lines or developing as air-mass storms. Most of the flood-producing rainfall in this region was from meso-scale convective storm cells. Such cells are usually well-separated during fall and spring months and so cover only parts of the land surface. Some 200 samples of suspended sediment collected in extremely arid watersheds were analyzed; bedload movement was found to be of major importance in the erosion and sedimentation process. Analysis of the rising limbs of flood hydrographs from Yael watersheds indicated a relationship between the duration of a rise to peak discharge, rainfall intensity, watershed infiltration and suspended sediment concentration. A sediment budget for the



## Field 2—WATER CYCLE

### Group 2A—General

Nahel Yael alluvial fan indicates net aggradation of about 1.5 cu m/year. The geologic structure of the watershed is summarized; surface flow in extreme desert terrain, streamflow and other related topics are discussed. (Jahns-Arizona) W76-13135

### 2B. Precipitation

**ATMOSPHERIC INPUT OF SOME CATIONS AND ANIONS TO FOREST ECOSYSTEMS IN NORTH CAROLINA AND TENNESSEE.** Forest Service (USDA), Franklin, N.C. Coweeta Hydrologic Lab. For primary bibliographic entry see Field 2K. W76-12838

**AN OVERVIEW OF THE PRECIPITATION PROCESSING SYSTEM AT THE SOUTHWEST WATERSHED RESEARCH CENTER.** Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center. For primary bibliographic entry see Field 7C. W76-13132

**GEOMORPHOLOGY AND CLIMATOLOGY OF ARID WATERSHEDS.** Hebrew Univ., Jerusalem (Israel). Dept. of Geography. For primary bibliographic entry see Field 2A. W76-13135

**COMPARISON STUDY OF MODELS USED TO PRESCRIBE HYDROMETEOR WATER CONTENT VALUES, PART I: PRELIMINARY RESULTS.** Air Force Cambridge Research Labs., Hanscom AFB, Mass. R. M. Pierce, R. W. Lenhard, and B. D. Weiss. Available from the National Technical Information Service, Springfield, Va 22161 as ADA-019 633, \$3.50 in paper copy, \$3.00 in microfiche. Report No. AFRL-TR-75-0470, ERP No. 532, September 5, 1975. 20 p, 3 fig, 2 tab, 6 ref.

**Descriptors:** \*Model studies, \*Mathematical models, \*Cloud physics, Analytical techniques, Atmosphere, Atmospheric physics, Clouds, Precipitation(Atmospheric), Rain, Snow, Ice, Meteorology.  
**Identifiers:** \*Liquid water content.

A preliminary study was made of several analytical techniques used to deduce profiles of integrated liquid water content (LWC). Comparison was made with aircraft and/or radar measurements for two sets of cases in order to determine if one or more of the modeling techniques would consistently yield more representative values than the others over a period of time. A brief description of the techniques used and the results of the statistical analyses applied to this study were presented. Also, a comparison of the integrated LWC for each case at the 10, 8, 6, 4 and 2 km and surface levels was presented in tabular form. Although it is possible to observe minor trends from this study, too few cases are presently available to reach any firm conclusion regarding the merits of one technique over any of the others. (Sims-ISWS) W76-13172

**THE CONTINUOUS ALUMINUM-FOIL HYDROMETEOR SAMPLER; DESIGN, OPERATION, DATA ANALYSIS PROCEDURES, AND OPERATING INSTRUCTIONS.** Air Force Cambridge Research Labs., Hanscom AFB, Mass. J. F. Church, K. K. Pocs, and A. A. Spatola. Available from the National Technical Information Service, Springfield, Va 22161 as AD/A-019 630, \$4.50 in paper copy, \$3.00 in microfiche. Report No. AFRL-TR-75-0370, IP No. 235, July 11, 1975. 70 p, 27 fig, 5 tab, 49 ref, 1 append.

**Descriptors:** \*Instrumentation, \*Cloud physics, \*Equipment, \*Sampling, Aircraft, Snow, Ice, Rain, Precipitation(Atmospheric), Drops(Fluids), Raindrops, Atmospheric physics, Atmosphere, Clouds, Data processing, Design, Analytical techniques, Meteorology.  
**Identifiers:** \*Meteorological instrumentation, Foil hydrometeor samplers.

This study presented results of research done on the continuous aluminum-foil hydrometeor sampler which is an airborne meteorological instrument that uses a continuous ribbon of aluminum-foil which moves at a constant speed past a 14.51-cu cm (2.25-cu in) sampling area aperture exposing the foil to the ambient air-flow inflight. Both liquid drops greater than 100 micrometers and solid particles greater than 50 micrometers could be identified, measured, and counted. The frozen particles, depending upon orientation, impacted on the foil leaving an almost exact replica. However, the imprint size of liquid drops could be up to 30% greater when sampled on a C-130 aircraft, depending on the true air speed of the sampling. Knowing the true aircraft speed, the foil advance speed, aperture width, and the ratio of imprint to true size, the hydrometeor size distribution and mass concentration could be determined along the aircraft's sampling path. But in certain special meteorological conditions, the accuracy of the extracted data was subject to the skills and subjective interpretation of the analyst. The continuous aluminum-foil hydrometeor samplers were subject to supercooled icing problems which on occasion have rendered the instruments inoperative. Subsequent modifications to include greater heating capability for the shutter and the area around the sampling aperture were made and were described. (Sims-ISWS) W76-13173

**AN ANALYSIS OF THE ERRORS ASSOCIATED WITH THE DETERMINATION OF ATMOSPHERIC TEMPERATURE FROM ATMOSPHERIC PRESSURE AND DENSITY DATA.** National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center. R. A. Minzner. Report No. NASA TN D-8014, January 1976. 35 p, 8 fig, 6 ref, 1 append.

**Descriptors:** \*Remote sensing, \*Air temperature, \*Density, \*Graphical analysis, \*Atmospheric pressure, Equations, Temperature, Height, Atmosphere, Atmospheric physics, Mathematics.  
**Identifiers:** \*Error analysis, Rocket soundings.

A graph was developed for relating delta T/T, the relative uncertainty in atmospheric temperature T, to delta p/p, the relative uncertainty in the atmospheric pressure p, for situations when T is derived from the slope of the pressure-height profile. A similar graph related delta T/T to delta rho/rho, the relative uncertainty in the atmospheric density rho, for those cases when T is derived from the downward integration of the density-height profile. A comparison of these two graphs showed that for equal uncertainties in the respective basic parameters, p or rho, smaller uncertainties in the derived temperatures are associated with density-height rather than with pressure-height data. The value of delta T/T was seen to depend not only upon delta p or delta rho, and to a small extent upon the value of T or the related scale height H, but also upon the inverse of Delta h, the height increment between successive observations of p or rho. In the case of pressure-height data, delta T/T was dominated by 1/Delta h for all values of Delta h; for density-height data, delta T/T was dominated by delta rho/rho, for Delta h smaller than about 5 km. Thus, while delta T/T = delta p/p for Delta h = (square root of 2) H, which is about 10 km, delta T/T increased to 10, 100, and 1000 times delta p/p as Delta h decreased successively to 1 km, 0.1 km, and 0.01 km respectively. In the case of T derived from density-height data, this inverse relationship between delta T/T and

Delta h applied only for large values of Delta h, that is, for Delta h greater than 35 km. For Delta h less than 1 km, delta T/T was congruent to delta rho/rho, independent of the size of Delta h. No limit existed in the fineness of usable height resolution of T which may be derived from densities, while a fine height resolution in pressure-height data led to temperatures with unacceptably large uncertainties. (Sims-ISWS) W76-13179

**STUDIES ON NUMERICAL MODELING AND MODIFICATION OF CYCLONE SCALE PRECIPITATION.** Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science. For primary bibliographic entry see Field 3B. W76-13185

**MESOMETEOROLOGICAL STUDIES OF PRECIPITATION.** Uppsala Univ. (Sweden). Dept. of Meteorology. T. Bergeron, and B. Dahlstrom. Available from the National Technical Information Service, Springfield, Va 22161 as AD-A022 484, \$4.00 in paper copy, \$3.00 in microfiche. Final Report 1973-75, December 31, 1975. 24 p, 8 fig, 3 tab, 16 ref, 1 append. Army DA-ERO-591-74-G0001.

**Descriptors:** \*Precipitation(Atmospheric), \*Rainfall, \*Cloud physics, \*Areal, Networks, Computers, Measurement, Equations, Weather patterns, Mathematical studies, On-site investigations, Meteorology.

The horizontal and vertical 'turbulence' and exchange set up and maintained by different macro-scale mechanisms (cyclones and anticyclones etc.) are well known. The role of convective air-mass clouds in this respect in the meso-scale has also been the subject of world-wide intense studies. As to the meso-scale study of apparently convective entities in the frontal and orogenic cloud systems, on the other hand, much less has been done. Therefore, it was one aim of this study to shed some light on that problem. It was confirmed that even these cloud-systems generally show a markedly 'granulated' and partly convective structure of their precipitation pattern, at least down to details with a horizontal extension of about 5 km. Moreover, this study showed that even the frontal cloud systems, and their precipitation, mostly are divided into well detached cells or units of varied origin. It was concluded that their propagation offers several aspects of interest to weather forecasting and are worth further research. (Sims-ISWS) W76-13186

### 2C. Snow, Ice, and Frost

**ON THE CALCULATION OF SURFACE SHEAR STRESS USING THE PROFILE METHOD.** Geological Survey, Tacoma, Wash. C. H. Ling. Journal of Geophysical Research, Vol 81, No 15, p 2581-2582, May 20, 1976. 2 fig, 7 ref.

**Descriptors:** \*Shear stress, \*Surfaces, \*Stress, \*Ice loads, Methodology, Equations, Evaluation, Boundaries(Surfaces), Roughness(Hydraulic).

Comparison of shear stress calculations has been made between the conventional profile method and the method proposed by Ling and Untersteiner, 1974-by using the corrected drag plate measurements of the Kansas Field Program of 1968 made by the Air Force Cambridge Research Laboratories. A von Karman constant of 0.35 has been used for this comparison. The proposed method gives better stress estimates and less scatter in the roughness parameter than the conventional method. (See W74-05164) (Woodard-USGS)

W76-12809

**CHANGES OCCURRING IN THE OCEANIC PORTION OF THE COLVILLE RIVER DELTA, ALASKA, DURING SPRING FLOODING,** Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology; and Louisiana State Univ., Baton Rouge. Coastal Studies Inst. H. J. Walker.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A009 031, \$3.50 in paper copy, \$3.00 in microfiche. Technical Report No. 181, March 1975. 8 p, 7 fig, 7 ref. Reprint from Proceedings, Second International Conference on Port and Ocean Engineering under Arctic Conditions, Reykjavik (Iceland), August 27-31, 1973, p 266-273. NR 388 002, ONR N00014-69-A-0211-0003.

Descriptors: \*Deltas, \*Rivers, \*Floods, \*Alaska, \*Arctic, Spring, Interfaces, Saline water-fresh-water interfaces, Sediments, Seasonal, Suspended solids, Permafrost, Snowmelt, Runoff, Salinity, Temperature, Water temperature, On-site investigations. Identifiers: \*Colville River Delta(Alaska), Spring flooding, Ice breakup.

The seawater which accumulates beneath the sea ice at the front of the Colville River delta during winter is replaced by fresh but turbid water during flooding accompanying breakup. The wedge that initially forms is very distinct, and the floodwater within it has relatively little influence on the salinity and temperature of the seawater beneath the interface. Data showed, however, that the suspended material transported seaward in the wedge settles through the interface and the seawater beneath the interface to be deposited on the bottom. (Sims-ISWS) W76-12997

**HEAT TRANSFER CHARACTERISTICS OF A BUBBLE-INDUCED WATER JET IMPINGING ON AN ICE SURFACE,** Cold Regions Research and Engineering Lab., Hanover, N.H., Research Div. Y-C. Yen.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A010 635, \$3.50 in paper copy, \$3.00 in microfiche. Research Report 335, April 1975. 16 p, 15 fig, 1 tab, 13 ref.

Descriptors: \*Bubbles, \*Ice, \*Heat transfer, \*Jets, Ice-water interfaces, Deicers, Ice cover, Lake ice, Laboratory tests, Equipment, Instrumentation, Mathematics, Equations. Identifiers: \*Ice prevention, Ice formation, Ice control.

An experimental study of the heat transfer characteristics of a bubble-driven water jet on an ice surface was conducted. Two Lucite columns, one 1.829 m high and 0.286 m in diameter and the other 1.219 m high and 0.140 m in diameter were used. Water levels were maintained at 0.762 and 1.524 m in the large column and 0.840 m in the small column. Hypodermic needles with openings of 0.152, 0.406 and 0.838 mm were used for bubble formation. The air flow rate was varied from 7.39 x 10 to the minus 8th power to 9.91 x 10 to the minus 7th power cu m/s. In all, 171 experimental runs were conducted. The results can be correlated by  $Nu = 0.1735 (Re \text{ sub } i)$  to the 0.848 power with a correlation coefficient of 0.84, in which  $Nu$  is defined in terms of average heat transfer coefficient, sample diameter, and thermal conductivity of water.  $Re \text{ sub } i$  is defined in terms of diameter of the impinging water jet at the ice surface, the centerline arrival water velocity, and the kinematic viscosity of water. (Sims-ISWS) W76-12998

# STRESS CONCENTRATION IN SLOPING SNOWPACK FROM GEOMETRIC IMPERFECTIONS,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics. T. E. Lang, and R. L. Brown.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-022 425, \$3.50 in paper copy, \$3.00 in microfiche. Report No. ARO 11042.2-EN, 1975. 10 p, 8 fig, 7 ref. DA-ARO-D-31-124-73-G 175, NSF GA-3943.

Descriptors: \*Snow cover, \*Stress, \*Creep, \*Model studies, Mathematical models, Equations, Stress analysis, Snow, \*Snowpacks, Shear, Shear stress, Slopes, Strain, Viscosity. Identifiers: Viscoelastic properties.

Results were presented from developed equations on the prediction of the state of stress and creep in an idealized sloping snow slab perturbed by a basal layer shear imperfection. Stress and strain rate intensification, maximum energy loci, stress dependence on viscoelastic properties, and other related parametric evaluations were summarized. The dependence of these parameters on slope angle and size of imperfection was reported. (Sims-ISWS) W76-13061

## 2D. Evaporation and Transpiration

### STUDIES ON THE POTENTIAL EVAPORATION OF LAWNS UNDER DIFFERENT CONDITIONS OF UNDERGROUND WATER: A COMPARISON OF CALCULATED VALUES WITH THE VALUES OF A LYSIMETER, (IN GERMAN),

Technische Universitaet, Hanover (West Germany). Institut fuer Meteorologie und Klimatologie. R. Kaviani. Z Acker Pflanzbau. 139(4), p 249-258, 1974.

Descriptors: \*Evaporation, Groundwater, \*Lysimeter, \*Analytical techniques, \*Humidity, \*Methodology, Soil moisture. Identifiers: Haude method, Albrecht method, Thornthwaite method.

A comparison of lysimeter measured values of potential evaporation with the values calculated by 3 different methods (Albrecht, Haude, Thornthwaite) shows considerable differences. Whereas the Albrecht-method gives very low values and the Thornthwaite-method very high ones, the Haude-method supplies satisfactory results which come close to the measured values of potential evaporation. Under these experimental conditions, there was a close correlation between the measured potential evaporation and the actual evaporation, when the soil-humidity remained above the wilting point.—Copyright 1975, Biological Abstracts, Inc. W76-12757

### QUANTITATIVE RELATIONSHIP BETWEEN REFLECTANCE AND TRANSPIRATION OF PHREATOPHYTES—GILA RIVER TEST SITE,

Geological Survey, Tucson, Ariz. R. C. Culler, J. E. Jones, and R. M. Turner. In: 4th Annual Earth Resources Program Review, Volume III, U.S. Geological Survey Programs, Houston, Texas, January 17-21, 1972: NASA, Manned Spacecraft Center MSC-05937, p 83-1 - 83-9, 1972. 3 fig, 6 ref.

Descriptors: \*Evapotranspiration, Measurement, \*Remote sensing, \*Aerial photography, \*Vegetation effects, \*Phreatophytes, Photogrammetry, Surveys, \*Arizona. Identifiers: \*Gila River test site(Ariz).

The feasibility of using aerial photographs to estimate evapotranspiration (ET) from large parcels of the landscape has been studied by the U.S.

Geological Survey at the Gila River Phreatophyte Project in Arizona for several years. Repetitive color-IR (infrared) aerial photography has been used since 1967 as a means of estimating the volume of transpiring vegetation covering the project site. As plants are one of the main avenues through which water vapor is lost from a hydrologic system, a measure of plant volume should provide a means for estimating the transpiration component of ET. The analysis described indicates that remote sensing can be used for this purpose. Color-IR photographs, using various film types, cameras, and filters, were obtained on 33 dates from 1967 through 1970. The photography and film processing was done by NASA and by the U.S. Geological Survey. All photographs were color transparencies. Most were taken from an elevation of 8,500 feet, and all were in 9-inch format. (Woodard-USGS) W76-12802

### FINITE DIFFERENCE AND FINITE ELEMENT SIMULATION OF FIELD WATER UPTAKE BY PLANTS,

Institute for Land and Water Management Research, Wageningen (Netherlands). For primary bibliographic entry see Field 2G. W76-12830

### THE SIMPLIFIED INTEGRAL MATHEMATICAL MODEL ON A SMALL LOW-LAND CATCHMENT,

Technical Univ. of Warsaw (Poland). Inst. of Environmental Engineering. For primary bibliographic entry see Field 2A. W76-12831

### SPRINKLER EVAPORATION LOSSES IN THE SOUTHERN PLAINS,

Southwestern Great Plains Research Center, Bushland, Tex. For primary bibliographic entry see Field 3F. W76-13004

### THERMAL LOADING OF HYCO LAKE, NORTH CAROLINA— THE EFFECT OF HEATED WATER ON TEMPERATURE AND EVAPORATION, 1966-74,

Geological Survey, Raleigh, N. C. For primary bibliographic entry see Field 5C. W76-13078

## 2E. Streamflow and Runoff

### A BRIEF HYDROLOGIC APPRAISAL OF THE JULY 3-4, 1975, FLASH FLOOD IN LAS VEGAS VALLEY, NEVADA,

Geological Survey, Carson City, Nev. For primary bibliographic entry see Field 4A. W76-12806

### A MATHEMATICAL MODEL FOR FLOOD-WAVE FORECASTING BY MEANS OF WARNING BASINS,

Institutul de Meteorologie si Hidrologie, Bucharest (Romania). For primary bibliographic entry see Field 4A. W76-12829

### A NOTE ON THE STEP ERROR OF SOME FINITE-DIFFERENCE SCHEMES USED TO SOLVE KINEMATIC WAVE EQUATIONS,

New Mexico Inst. of Mining and Technology, Socorro. V. P. Singh. Journal of Hydrology, Vol. 30, No. 3, p 247-255, July 1976. 1 fig, 17 ref.

Descriptors: \*Numerical analysis, \*Hydrology, \*Analytical techniques, \*Methodology, Compu-

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

ters, Mathematics, Approximation method, Equations, Stability, Mathematical studies.  
Identifiers: \*Kinematic wave equation, \*Finite-difference schemes, Convergence, Discretization error, Step error.

The magnitude of the discretization error in numerical solutions of kinematic wave equations depends on the step length of distance,  $x$ , and time,  $t$ , in  $x, t$  space. A round-off error is introduced each time a calculation is done. A set of finite difference equations is stable when the cumulative effect of all round-off errors is negligible. The total error is the sum of the discretization and stability errors. The discretization error is dominant in a stable and convergent scheme. An analytical treatment was developed for the discretization or step error of some finite difference schemes that are frequently used to solve the kinematic wave equations. It was shown that for convergent and stable schemes the production of step error of one scheme may not be the same as that of another. The distinction must be considered in choosing between the schemes. It was found that knowledge of step error is a useful parameter to estimate a priori the step length to be used in a given scheme. (Singh-ISWS)  
W76-12834

**EFFECTS OF OVERBANK FLOW IN FLOOD COMPUTATIONS.**  
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.  
T. Tingsanchali, and N. L. Ackermann.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY7, Proceedings Paper 12266, p 1013-1025, July 1976. 8 fig, 10 ref, 2 append.

Descriptors: \*Flood plains, \*Floods, \*Unsteady flow, \*Overland flow, River flow, Continuity equation, Momentum equation, Hydraulics, Channel morphology, Mathematical models, Rivers, Equations, Berns.  
Identifiers: \*Philippines, \*Bicol River(Philippines).

The derivation and application of unsteady free surface flow equations which describe floods in rivers where dynamic effects are considered in both the main channel as well as berm or overbank sections of the flood plain were presented. Literature to date considers overbank portions of a river significant only for purposes of storage. Such an assumption is not always justified. The equations were used to describe flood conditions that occurred in 1970 in the Bicol River Basin in South Luzon, Philippines. The dynamic effects of the flow in the berms were determined by comparing the computed river stages and discharges considering conditions with and without the dynamic effects of the berm flow. (Lardner - ISWS)  
W76-12976

**A MATHEMATICAL MODEL OF THE 'RESERVOIR' TYPE DESIGNED FOR FLOOD-WAVE MODELLING AND FORECASTING.**  
Institutul de Meteorologie si Hidrologie, Bucharest (Romania).  
For primary bibliographic entry see Field 2A.  
W76-12979

**AN ADAPTIVE IDENTIFICATION AND PREDICTION ALGORITHM FOR THE REAL-TIME FORECASTING OF HYDROLOGICAL TIME SERIES.**  
International Inst. for Applied Systems Analysis, Laxenburg (Austria).  
For primary bibliographic entry see Field 2A.  
W76-12980

**COMPILING BATHYMETRY FOR FLOW SIMULATION MODELS.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.

W76-13064

**INDEX TO NATIONAL TOPOGRAPHIC MAPS: 1:250,000-SCALE SERIES.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-13077

**ESTIMATING PEAK DISCHARGES FROM SMALL DRAINAGES IN NEVADA ACCORDING TO BASIN AREAS WITHIN ELEVATION ZONES.**  
Geological Survey, Carson City, Nev.  
For primary bibliographic entry see Field 4A.  
W76-13080

**A SIMPLIFIED SLOPE-AREA METHOD FOR ESTIMATING FLOOD DISCHARGES IN NATURAL CHANNELS.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 4A.  
W76-13083

**TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW FREQUENCY CHARACTERISTICS OF STREAMS IN THE SUSQUEHANNA RIVER BASIN.**  
Geological Survey, Harrisburg, Pa.  
For primary bibliographic entry see Field 4A.  
W76-13086

## 2F. Groundwater

**FLUCTUATIONS OF GROUND-WATER LEVELS IN LEE COUNTY, FLORIDA, IN 1974.**  
Geological Survey, Tallahassee, Fla.  
For primary bibliographic entry see Field 4B.  
W76-12801

**HYDROLOGY OF LIMESTONE TERRANES, PROGRESS OF KNOWLEDGE ABOUT HYDROLOGY OF CARBONATE TERRANES.**  
Geological Survey of Alabama, University.  
P. E. LaMoreaux, H. E. LeGrand, V. T. Stringfield, J. S. Tolson, and W. M. Warren.  
Bulletin 94, Part E, July 1975. 168 p, 1 tab, 103 ref.

Descriptors: \*Carbonate rocks, \*Terrain analysis, \*Karst hydrology, \*Karst, Paleohydrology, Bibliographies, Limestones, Rocks, Sinks, Caves, Groundwater, Geology, Land use, Geomorphology, Reviews, Hydrogeology.  
Identifiers: Subsurface hydrology, Limestone hydrology studies, Limestone terranes, Chalk.

Carbonate rocks, primarily limestones and dolostones, comprise roughly 15% of all sedimentary rocks that underlie 75% of the earth's surface. These rocks are of great economic importance for their own value and contain, in places, large amounts of groundwater, an important quantity of the world's supply of petroleum and natural gas, and valuable reserves of the world's metals. Because of their unique and complex characteristics, a great deal of research has been dedicated to the study of carbonate rocks. In the past decade, there has been an increased interest in carbonate rocks and, particularly, their hydrologic characteristics. Literature on carbonate rocks, describing their influence on man, appears in publications of all types, ranging from special or feature stories in newspapers and magazines to technical journals, textbooks, and treatises. The sources of the literature are worldwide, illustrating the wide distribution of carbonate rocks and their importance to man. This literature survey covered the progress of knowledge about hydrology of carbonate terranes. A 795-entry, annotated bibliography of carbonate rocks was included in this volume. (Sims-ISWS)  
W76-12813

**PUBLIC GROUNDWATER SUPPLIES IN LAKE COUNTY.**  
Illinois State Water Survey, Urbana.  
For primary bibliographic entry see Field 4B.  
W76-12824

**ONSET OF THERMOHALINE CONVECTION IN A CAVERNOUS AQUIFER.**  
Florida Univ., Gainesville. Dept. of Civil Engineering.  
H. Rubin.  
Water Resources Research, Vol. 12, No. 2, p 141-147, April 1976. 3 fig, 21 ref.

Descriptors: \*Groundwater, \*Geothermal studies, \*Convection, \*Florida, \*Aquifers, Equations, Mathematical studies, Mathematical models, Heat flow, Heat transfer, Thermal water, Flow, Hydrothermal studies, Caves, Stability, Mathematics.  
Identifiers: \*Thermohaline convection, \*Floridan aquifer, \*Cavernous aquifer, \*Solute dispersion, \*Perturbation analysis, Instability criteria, Thermal gradient.

In some groundwater aquifers, geothermal activity may lead to thermal convection. In such cases, very often saline hot water is transferred from the deep layers of the aquifer into the upper layers. There is an hypothesis that such a mechanism does exist in the deep regions of the Floridan aquifer. However, the deep zone of the Floridan aquifer is extremely cavernous. Therefore even very slow motions may lead to an intensive dispersion of soluted materials and heat as well as to turbulent effects demonstrated by the invalidity of the laminar Darcy law. In this study, all these effects and their connection with the onset of thermohaline convection were investigated. It was found possible to define in the field a plane where applied perturbations are the most disturbing to the flow field. In this plane, convection motions initiated. This plane formed an angle theta sub c with the unperturbed velocity vector. Angle theta sub c varied according to flow conditions between 0 and 90 degrees. Approaches were developed for the determination of instability criteria for different regions of the Reynolds number. (Prickett-ISWS)  
W76-12835

**ANALYSIS OF AQUIFER-AQUITARD FLOW.**  
Birmingham Univ. (England). Dept. of Civil Engineering.  
T. D. Streltsova.  
Water Resources Research, Vol. 12, No. 3, p 415-422, June 1976. 8 fig, 15 ref.

Descriptors: \*Equations, \*Aquifers, \*Aquitards, \*Groundwater movement, \*Drawdown, Water wells, Water table, Leakage, Flow system, Hydraulic properties, Graphical analysis, Mathematical studies, Permeability, Storage coefficient, Specific yield, Flow.  
Identifiers: \*Partial penetration, \*Type curves.

The general drawdown equation and its particular cases were considered for a partially penetrating well discharging at a constant rate from an aquifer which is overlain by an aquitard containing the water table. An identity was established between the exact solutions, developed in terms of the  $\rho = \mu(r)/h$  parameter, and those based on the finite difference approximation, developed in terms of the  $r/B$  parameter. The relations in the  $\rho$  and the  $r/B$  parameter were given for a well of complete penetration. The quasi-steady drawdown equation was developed for a well of partial penetration in an aquifer-aquitard flow system. The solution was graphically presented, and its use in the distance-drawdown curve-matching procedure was described. Determination of the aquifer-aquitard formation constants was discussed. (Visocky-ISWS)  
W76-12836



**THE CONDUCT OF CERTAIN LONG-LIVED ISOTOPES IN ROCKS IN THE CASE OF THEIR CONTAMINATION WITH NONTECHNICAL EFFLUENTS OF THE ATOMIC ELECTRIC POWER STATIONS (AES), (IN RUSSIAN),**  
For primary bibliographic entry see Field 5B.  
W76-12908

**GROUND WATER MOVEMENT,**  
National Water Well Association, Worthington, Ohio.  
For primary bibliographic entry see Field 4B.  
W76-13031

**DYNAMICS OF SALTS SiO<sub>2</sub>, R<sub>2</sub>O<sub>3</sub>, MnO AND WATER-SOLUBLE ORGANIC MATTER IN UNDERGROUND WATER, (IN RUSSIAN),**  
Akademiya Nauk SSSR, Novosibirsk. Inst. of Soil Sciences and Agrochemistry.  
For primary bibliographic entry see Field 5B.  
W76-13043

**AVAILABILITY OF GROUND WATER IN THE MIDDLE CONNECTICUT RIVER BASIN, WEST-CENTRAL NEW HAMPSHIRE,**  
Geological Survey, Concord, N. H.  
For primary bibliographic entry see Field 7C.  
W76-13062

**TWO-DIMENSIONAL STEADY-STATE DISPERSION IN A SATURATED POROUS MEDIUM,**  
Geological Survey, Menlo Park, Calif.  
A. Ogata.  
Journal of Research of the U S Geological Survey, Vol 4, No 3, p 277-284, May-June 1976. 6 fig, 10 ref.

Descriptors: \*Groundwater movement, \*Porous media, \*Dispersion, \*Mathematical models, Mass transfer, Saturated flow.  
Identifiers: \*Groundwater tracer.

A previously developed analytical solution for two-dimensional dispersion of groundwater is computed for various conditions. These results were then compared with solution of previously developed approximate models of transverse dispersion which were used to analyze experimentally derived concentration distribution. Comparison established that, whenever steady state was reached, the values of dispersion coefficient computed using the approximate expression agreed with values derived from exact expression and in addition allowed a quick computation of the parameter. (Woodard-USGS)  
W76-13071

**GEOLOGY AND GROUND-WATER RESOURCES OF UNION COUNTY, NEW JERSEY,**  
Geological Survey, Trenton, N. J.  
For primary bibliographic entry see Field 4B.  
W76-13072

**GEOHYDROLOGY OF THE OKLAHOMA PANHANDLE, BEAVER, CIMARRON, AND TEXAS COUNTIES,**  
Geological Survey, Oklahoma City, Okla.  
For primary bibliographic entry see Field 4B.  
W76-13081

**DIGITAL MODELS OF A GLACIAL OUTWASH AQUIFER IN THE PEARL-SALLIE LAKES AREA, WEST-CENTRAL MINNESOTA,**  
Geological Survey, St. Paul, Minn.  
S. P. Larson, M. S. McBride, and R. J. Wolf.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 070, \$4.00 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 40-75, November 1975. 39 p, 15 fig, 1 tab, 18 ref.

Descriptors: \*Surface-groundwater relationships, \*Aquifer characteristics, \*Lakes, \*Groundwater movement, \*Model studies, Hydrogeology, Inflow, Discharge(Water), Mathematical models, Water level fluctuations, Seepage, Leakage, Computer models, Cross-sections, \*Minnesota.  
Identifiers: West-central Minnesota, \*Pearl-Sallie Lakes area(Minn).

The need for study of lake-ground-water interchange has been accentuated by eutrophication of lakes in the Pearl-Sallie Lakes area of west-central Minnesota. The local ground-water flow system is dominated by a sand and gravel outwash aquifer that is sandwiched between two layers of till in the western part of the area and exposed at the land surface in the eastern part. Water discharges from the aquifer into lakes in the outwash area but the aquifer is recharged from lakes in the till-covered area. Irregular aquifer geometry has resulted in a complex ground-water flow system. Simulation of the system by areal and vertical-section models has shown that the lakes significantly control ground-water flow near their shores. Evaluation of the models has indicated that they may be used to guide field-data collection, interpretation of data, and quantification of the ground-water flow system. With modification, the models could be used to predict aquifer response to transient stresses. Also, they could be incorporated into more complex models, to determine the movement of solutes in the ground-water system. (Woodard-USGS)  
W76-13082

**FACTORS AFFECTING DECLINING WATER LEVELS IN A SEWERED AREA OF NASSAU COUNTY, NEW YORK,**  
Geological Survey, Albany, N. Y.  
For primary bibliographic entry see Field 5B.  
W76-13084

**FINITE-DIFFERENCE MODEL FOR AQUIFER SIMULATION IN TWO DIMENSIONS WITH RESULTS OF NUMERICAL EXPERIMENTS,**  
Geological Survey, Reston, Va.  
P. C. Trescott, G. F. Pinder, and S. P. Larsen.  
Techniques of Water-Resources Investigations, Book 7, Chapter C1, 1976. 116 p, 33 fig, 3 tab, 28 ref.

Descriptors: \*Computer models, \*Groundwater movement, \*Saturated flow, \*Numerical analysis, Methodology, Forecasting, Groundwater, Water table, Confined water, Aquifers, Computer programs.  
Identifiers: \*FORTRAN IV, Two-dimensional simulation, Finite-difference methods, Strongly implicit procedure.

The model will simulate ground-water flow in an artesian aquifer, a water-table aquifer, or a combined artesian and water-table aquifer. The aquifer may be heterogeneous and anisotropic and have irregular boundaries. The source term in the flow equation may include well discharge, constant recharge, leakage from confining beds in which the effects of storage are considered, and evapotranspiration as a linear function of depth to water. The theoretical development includes presentation of the appropriate flow equations and derivation of the finite-difference approximations (written for a variable grid). The documentation emphasizes the numerical techniques that can be used for solving the simultaneous equations and describes the results of numerical experiments using these techniques. The documentation includes a flow chart, program listing, an example simulation, and sections on designing an aquifer model and requirements for data input. It illustrates how model results can be presented on the line printer and pen plotters with a program that utilizes the graphical display software available from the Geological Survey Computer Center Division. In addition the model includes options for reading input data from a disk and writing intermediate results on a disk. (Woodard-USGS)

W76-13085

**VERTICAL TEMPERATURE AND CHEMICAL GRADIENTS IN GROUNDWATER IN THE TUCSON BASIN, ARIZONA,**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
For primary bibliographic entry see Field 4B.  
W76-13129

## 2G. Water In Soils

**INTER-RELATION OF KEY-FACTORS FOR INFILTRATION OF LIQUID DOMESTIC WASTE INTO SOIL,**  
Connecticut Univ., Storrs.  
For primary bibliographic entry see Field 5D.  
W76-12679

**STUDIES ON THE INTERACTIONS BETWEEN SOIL WATER AND THINLY DISPERSED SOLID MATTER USING THE MOIST HEAT METHOD, (IN ROMANIAN),**  
Institutul de Studii si Cercetari Pedologie, Bucharest (Romania).  
S. Balan.  
An Inst Stud Cercet Pedol. 40, p 13-29, 1972.

Descriptors: \*Soil water, \*Soils, Soil profiles, Dispersion, Soil texture, Cation exchange, Heat, \*Soil moisture.  
Identifiers: \*Moist heat method.

About 300 determinations were made with the moist heat method in different types of soils including a wide range of variations from acid brown sandy soils up to intensely clayey vertic wet meadow soils. Determinations were made in all horizons and subhorizons, at the same levels at which the other determinations and physical, chemical and mineralogical analysis were performed. The values of moist heat were influenced by different factors, the more important ones being texture, humus, mineral composition, cation exchange capacity and soil structure. The moist heat determined on the whole soil profile was used to estimate the effective soil particle surface area. The results are in agreement with literature data obtained for similar soils.—Copyright 1975, Biological Abstracts, Inc.  
W76-12706

**COMPARATIVE STUDIES OF PLANT GROWTH AND DISTRIBUTION IN RELATION TO WATERLOGGING: VII. THE INFLUENCE OF WATER-TABLE FLUCTUATIONS ON IRON AND MANGANESE AVAILABILITY IN DUNE SLACK SOILS,**  
Trent Univ., Peterborough (Ontario). Dept. of Biology.  
For primary bibliographic entry see Field 21.  
W76-12708

**EDAPHIC FACTORS IN SPECIES AND ECOTYPE DIFFERENTIATION OF SAGITTARIA,**  
Iowa State Univ., Ames. Dept. of Botany and Plant Pathology.  
J. W. Wooten.  
J Ecol. 61(1), p 151-156, 1973.

Descriptors: \*Aquatic plants, \*Soils, Hydrogen ion concentration, Calcium, Phosphorus, Potassium.  
Identifiers: \*Ecotype differentiation, Sagittaria-Graminea-Var-Weatherbiana, \*Sagittaria, Sagittaria-Cristata, Sagittaria-Graminea, Sagittaria-Graminea-Var-Chapmani, Sagittaria-Graminea-Var-Graminea, Sagittaria-Platyphylla.

Soil from populations of 4 ecotypes of 2 varieties within the *S. graminea* complex (*S. graminea* var. *weatherbiana*, *S. graminea* var. *chapmani*), a 3rd

## Field 2—WATER CYCLE

### Group 2G—Water In Soils

variety of this complex (*S. graminea* var. *graminea*), and from populations of *S. cristata* and *S. platyphylla* were analyzed. Values for pH, CaO, MgO, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were established, and tests for significance of the data made. Significant soil nutrient levels were established that were characteristic for and served to delimit each taxon. Two of the 4 ecotypes were found to be specific to certain soils. Edaphic adaptation appears to be of importance in this group of plants and may be of significance in other hydrophytes.—Copyright 1974, Biological Abstracts, Inc. W76-12739

**STUDIES ON THE POTENTIAL EVAPORATION OF LAWNS UNDER DIFFERENT CONDITIONS OF UNDERGROUND WATER: A COMPARISON OF CALCULATED VALUES WITH THE VALUES OF A LYSIMETER, (IN GERMAN),** Technische Universitaet, Hanover (West Germany). Institut fuer Meteorologie und Klimatologie. For primary bibliographic entry see Field 2D. W76-12757

**MEASUREMENT AND EVALUATION METHODS FOR THE DETERMINATION OF THE UNSATURATED HYDRAULIC CONDUCTIVITY OF SOILS IN SITU, (IN GERMAN),** U. Krahmer. Z. Pflanzenernaehr Bodenkd. 137(2), p 95-107, 1974.

Descriptors: Hydraulic conductivity, Measurement, Methodology, Soils, Evaporation, Soil profiles, Soil moisture, Tension, Tensiometers.

The unsaturated hydraulic conductivity was determined as a function of the moisture tension in 32 soil profiles in situ. Values were typical of Nordrhein-Westfalen (Germany) and included ground- and static-water profiles. The surface of the almost saturated soil was subjected to evaporation and changes in moisture and potential in the soil were measured. Measurements were made with Neutron moisture gauges and tensiometers. A given moisture tension increase in any soil compartment was attributed to a change in water content. The combined gauge and tensiometer measurements were analyzed using the Darcy and continuity equations for the quasistable state with the help of electronic data processing equipment.—Copyright 1975, Biological Abstracts, Inc. W76-12799

**INVESTIGATIONS CONCERNING MAPPING AND CLASSIFYING OF MARSH SOILS, (IN GERMAN),** Kiel Univ. (West Germany). Geologisch-Palaeontologisches Institut und Museum. W. Prange, G. Bruemmer, and E. Weber. Meyniana. 25, p 59-86, 1974.

Descriptors: \*Soil classification, \*Mapping, Europe, Ion exchange, Clays, Soil compaction, Marsh management, Soil compaction. Identifiers: West Germany, \*Marsh soils, \*Calcium magnesium ration.

Results from a large scale soil mapping on the North Frisian (West Germany) mainland indicate that field characteristics, particularly the grain-size, bedding and degree of compaction, are closely correlated with each other and with other field and laboratory data. Exchangeable ions and the Ca/Mg-ratio, however, indicate no connections with the soil units and with most of the other field characteristics but are determined by processes of the development of soil and landscape, such as desalting and decalcification, silicate weathering, fresh- and salt-water inundations, salty precipitations, salty groundwater and fertilization. Therefore the Ca/Mg-ratio is not suitable for differentiating between more clayey compacted

Knick-marsh soils and less clayey permeable Klei-marsh soils.—Copyright 1975, Biological Abstracts, Inc. W76-12814

**FINITE DIFFERENCE AND FINITE ELEMENT SIMULATION OF FIELD WATER UPTAKE BY PLANTS,** Institute for Land and Water Management Research, Wageningen (Netherlands). R. A. Feddes, P. Kowalik, S. P. Neuman, and E. Bresler. Hydrological Sciences Bulletin, Vol. 21, No. 1, p 81-98, March 1976. 15 fig, 10 ref.

Descriptors: \*Finite element analysis, Flow, \*Soil management, \*Soil investigations, \*Plant growth, Hydraulic conductivity, Root zone, Soil water, Numerical analysis, Water balance, Evapotranspiration, Unsteady flow, \*Soil-water-plant relationships, Moisture content. Identifiers: \*Finite element simulation, Soil-plant system, Root-soil interface.

The problem of non-steady flow of water in a soil-plant system was described by adding a sink term to the continuity equation for soil water flow. The sink term was defined in two different ways. First, it was considered to be dependent on the hydraulic conductivity of the soil, on the difference in pressure head between the soil and the root-soil interface, and some root effectiveness function. Second, the sink was taken to be a prescribed function of the soil water content. The partial differential equation applying to the first problem was solved by both the finite difference and a finite element technique. The equation applying to the second problem was solved by a finite difference approach. The paper verified the numerical models against field measurements. It compared the results obtained by the three numerical methods and showed how the finite method could be applied to complex but realistic two-dimensional flow situations. Two examples were given. The first example concerned one-dimensional flow. It compared numerical results with those obtained experimentally in the field from water balance studies on red cabbage grown on a clay soil in the presence of the water table. The second example described two-dimensional flow in a complex field situation in the Netherlands where flow took place under cropped field conditions through five anisotropic layers. Water was supplied to the system by infiltration from two unlined ditches and was withdrawn from the system by evapotranspiration and by leakage to an underlying pumped aquifer. (Roberts-ISWS) W76-12830

**A NEW MODEL FOR PREDICTING THE HYDRAULIC CONDUCTIVITY OF UNSATURATED POROUS MEDIA,** Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering. Y. Mualem. Water Resources Research, Vol. 12, No. 3, p 513-522, June 1976. 4 fig, 3 tab, 34 ref, 3 append. U.S.-ISBF 422.

Descriptors: \*Unsaturated flow, \*Hydraulic conductivity, \*Mathematical models, \*Porous media, Moisture content, Pore pressure, Saturation, Theoretical analysis, Soil properties, Homogeneity, Porosity, Capillary conductivity, Soil types, Model studies, Equations, Mathematical studies. Identifiers: \*Tortuosity.

A simple analytic model was proposed which predicts the unsaturated hydraulic conductivity curves by using the moisture content-capillary head curve and the measured value of the hydraulic conductivity at saturation. It was similar to the Childs and Collis-George (1950) model but used a modified assumption concerning the hydraulic conductivity of the pore sequence in order to take into account the effect of the larger pore section.

A computational method was derived for the determination of the residual water content and for the extrapolation of the water content-capillary head curve as measured in a limited range. The proposed model was compared with the existing practical models of Averjanov (1950), Wyllie and Gardner (1958), and Millington and Quirk (1961) on the basis of the measured data of 45 soils. It seemed that the new model is in better agreement with observations. (Visocky-ISWS) W76-12837

**WETTING FRONT PRESSURE HEAD IN THE INFILTRATION MODEL OF GREEN AND AMPT,** Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. S. P. Neuman. Water Resources Research, Vol. 12, No. 3, p 564-566, June 1976. 22 ref.

Descriptors: \*Soil water movement, \*Model studies, Mathematical studies, \*Infiltration, \*Pore pressure, \*Pressure head, \*Air circulation, Wetting, Water pressure, Seepage, Soil properties, Time, Gravitational water sorption, Unsaturated flow, Equations. Identifiers: \*Wetting front, \*Infiltration model, \*Green-Ampt model, \*Sorptivity.

A theoretical expression relating the wetting front pressure head in the infiltration model of Green and Ampt to soil characteristics was derived. This expression was identical to that previously suggested by Bouwer on the basis of an analogy with horizontal flow. It differed from a more complete expression recently proposed by Morel-Seytoux and Khanji in that the effect of air mobility was neglected, the need for determining the functional relationship between the relative permeability of air and water saturation thus being avoided. (Prickett-ISWS) W76-12839

**TRANSIENT DISPERSION IN UNIFORM POROUS MEDIA FLOW,** Sargent and Lundy, Chicago, Ill. For primary bibliographic entry see Field 5B. W76-12842

**INVESTIGATIONS ON THE WATER REGIME OF THE MAIN SOIL TYPES OF THE CRIS RIVER PLAIN, (IN ROMANIAN),** Institutul de Studii si Cercetari Pedologice, Bucharest (Romania). I. Vlas, and E. Stepanescu. An Inst Stud Cercet Pedol. 40, p p 89-98, 1972(1974).

Descriptors: \*Flood plains, \*Soil types, \*Chernozems, Wheat, Corn(Field), Physical properties, Chemical properties, Hydraulic properties. Identifiers: \*Cris River plain(Romania).

Studies were carried out for 4 yr on the main soil types (medium leached chernozem free of phreatic supply, medium leached chernozem-like meadow soil, wet meadow soil, brown flood plain and alluvial soils) under wheat and corn. The physical-chemical and hydric properties (wilting coefficient, field moisture capacity and available water capacity) are described, and the water regime is determined in terms of soil types and plant requirements. In these soils the type of water regime is differentiated in terms of their main properties. In medium leached chernozems without water supply, the water regime is periodically deep-penetrating; in medium leached chernozems, wet meadow and alluvial soils, it is at times, deeply phreatic and capillary.—Copyright 1975, Biological Abstracts, Inc. W76-12856

## WATER CYCLE—Field 2

### Water In Soils—Group 2G

**EFFECT OF THE SOIL MOISTURE REGIME ON THE PASSAGE OF STRONTIUM-90, CESIUM-137 AND CERIUM-144 FROM SOIL INTO SOLUTION, (IN RUSSIAN),** Ural Science Center, Sverdlovsk (USSR). Inst. of Plant and Animal Ecology.  
For primary bibliographic entry see Field 5B.  
W76-12868

**BEHAVIOR OF CESIUM-137 IN SOILS AND SOIL-PLANT SYSTEMS, (IN POLISH),** Polish Academy of Sciences, Warsaw. Agricultural Isotopes Lab.  
For primary bibliographic entry see Field 5B.  
W76-12909

**CHEMICAL AND PLANT EXTRACTABILITY OF METALS AND PLANT GROWTH ON SOILS AMENDED WITH SLUDGE,** Department of Agriculture, Ottawa (Ontario). Soil Research Inst.  
For primary bibliographic entry see Field 5B.  
W76-12929

**APPROXIMATIONS FOR VERTICAL INFILTRATION RATE PATTERNS,** Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.  
R. E. Smith.  
Transactions of the American Society of Agricultural Engineers, Vol. 19, No. 3, p 505-509, May-June 1976, 3 fig, 19 ref.

Descriptors: \*Infiltration, \*Soil physics, \*Infiltration rates, \*Unsaturated flow, \*Soil water movement, Soils, Porous media, Equations, Soil properties, Mathematical models, Unsteady flow, Computer models, Model studies.

The need for description of the time-varying rate of infiltration into soils led to the development of empirical formulas before the physics of fluid flow in porous media provided theoretical tools for analysis of this aspect of unsaturated soil water movement. Selected contributions toward a usable description of the surface-soil infiltration rate for two boundary and initial conditions were reviewed. The approximations ranged from simple formulas to complex models developed from computer analysis of Richards' equation. The trade-offs in number of parameters and accuracy were discussed for several infiltration models. (Adams - ISWS)  
W76-12977

**LOSSES OF NITROGEN IN SURFACE RUNOFF IN THE BLACKLAND PRAIRIE OF TEXAS,** Texas Agricultural Experiment Station, College Station.  
For primary bibliographic entry see Field 5G.  
W76-12982

**PORE VOLUME DISTRIBUTION AND CURVE OF WATER CONTENT VERSUS SUCTION OF POROUS BODY: 1. TWO BOUNDARY DRYING CURVES,** Tokyo Univ. (Japan). Lab. of Soil Hydrology.  
M. Nakano.  
Soil Science, Vol. 122, No. 1, p 5-14, July 1976, 7 fig, 2 tab, 21 ref.

Descriptors: \*Porosity, \*Moisture content, \*Mathematical models, \*Theoretical analysis, \*Porous media, Pore water, Saturation, Probability, Drying, Curves, Graphical analysis, Tubes, Model studies, Volume, Pores.  
Identifiers: Pore shape, Pore radius, Pore volume.

A pore model was proposed. It was a cylindrical tube whose cross section expanded (0-type) or diminished (X-type) from the inlet towards the middle. Pore volume distribution was derived by using the probability concept. Its density function

was an exponential function. The saturation boundary drying curve and the ultimate curve of water content of porous body versus suction were also derived. These curves were represented by three physical parameters, one characterizing pore volume distribution, one showing the minimum pore radius, and one representing pore shape. These theoretical curves were compared to experimental data and were found to be in good agreement for sand and sandy soil. (Visocky - ISWS)  
W76-12984

**MODEL FOR PREDICTING SIMULTANEOUS MOVEMENT OF NITRATE AND WATER THROUGH A LOAMY SAND,** Wisconsin Univ., Madison. Dept. of Soil Science.  
For primary bibliographic entry see Field 5B.  
W76-12985

**SOLUTE DISPERSION IN SATURATED SOIL COLUMNS,** Connecticut Agricultural Experiment Station, Storrs. Dept. of Soil and Water.  
For primary bibliographic entry see Field 5B.  
W76-12986

**SEDIMENT FROM DRAINAGE SYSTEMS FOR A HEAVY SOIL,** Ohio State Univ., Columbus. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W76-13001

**SPRINKLER IRRIGATION PERCOLATION LOSSES,** Agricultural Research Service, Morris, Minn.  
For primary bibliographic entry see Field 3F.  
W76-13005

**PHYSICAL-CHEMICAL COMPOSITION OF ERODED SOIL,** Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 2J.  
W76-13010

**LEAF WATER POTENTIAL AND MOISTURE BALANCE--FIELD DATA,** Agricultural Research Service, Auburn, Ala.; and Alabama Agricultural Experiment Station, Auburn.  
For primary bibliographic entry see Field 2I.  
W76-13011

**DEFLECTION-STIFFNESS CHARACTERISTICS OF CORRUGATED PLASTIC TUBING,** Ohio Agricultural Research and Development Center, Columbus.  
For primary bibliographic entry see Field 4A.  
W76-13018

**PREDICTED VERSUS MEASURED DRAINABLE POROSITIES,** North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.  
For primary bibliographic entry see Field 4A.  
W76-13019

**AN EXPERIMENT WITH A LINEARLY INCREASING SPACING OF SUBSURFACE DRAINS,** Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 4A.  
W76-13020

**EFFECT OF OPENINGS ON INFLOW INTO CORRUGATED DRAINS,** Ohio Agricultural Research and Development Center, Columbus.  
For primary bibliographic entry see Field 4A.  
W76-13021

**TILLAGE, MATRIC POTENTIAL, OXYGEN AND MILLET YIELD RELATIONSHIPS IN A LAYERED SOIL,** Agricultural Research Service, Florence, S.C. Coastal Plains Soil and Water Conservation Research Center.  
For primary bibliographic entry see Field 3F.  
W76-13022

**SOIL MOISTURE REGIME WITH SUBIRRIGATION,** Universidad del Valle, Cali (Colombia).  
R. Vallderuten, J. T. Ligon, and J. R. Lambert.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975. Chicago, Illinois, 29 p, 14 fig, 14 ref. ASAE Paper 75-2576.

Descriptors: \*Soil moisture, \*Irrigation, \*Subsurface irrigation, \*Model studies, Simulation analysis, Soil-water-plant relationships, Climatic data.

A simulation model was developed to predict the soil moisture regime with subirrigation. Conclusions drawn from the performance of the model are: (1) the simulation model incorporating some plant physical characteristics, soil and water properties, and climatic variables, gave reasonable results; (2) the physical process of water movement from the water table through the root system under subirrigation conditions is highly related to the evaporative losses at the surface; (3) water uptake by the root system is influenced by the root distribution and by the hydraulic characteristics of the soil; (4) a relatively small portion of the roots located in the vicinity of the water table is responsible for a large part of the water uptake; and (5) further studies involving a fluctuating water table in heterogeneous soils are needed to obtain a simulation model more representative of the actual case. (Skogerboe-Colorado State)  
W76-13023

**PLANT WATER STRESS CRITERIA FOR IRRIGATION SCHEDULING,** North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.  
E. C. Stegman, L. H. Schiele, and A. Bauer.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975. Chicago, Illinois, 22 p, 7 fig, 6 tab, 18 ref. ASAE Paper 75-2555.

Descriptors: \*Soil water, \*Soil moisture, \*Soil-water-plant relationships, \*Scheduling, Crop response, Plant physiology, Plant tissues, Irrigation, Irrigation effects.

This study was conducted to determine the potential for relating plant water stress development to variables indicative of prevailing soil and atmospheric environments. Given such relationships irrigation scheduling services should be better able to use plant stress oriented criteria for determining when to irrigate. Stress development was evaluated by leaf xylem pressure and stomatal diffusion resistance measurements. Data sets were obtained for 4 to 5 crops at two Irrigation Branch Stations in North Dakota. The two sites provided soil types with differing hydraulic properties and available water holding capacities. Leaf xylem pressure data for each crop-soil combination were correlated by regression procedures with ambient air temperatures and root zone soil moisture content. Subsequent application of these xylem pressure levels as critical limits to each regression model permitted estimation of allowable root zone soil



## Field 2—WATER CYCLE

### Group 2G—Water In Soils

moisture depletion relative to expected ambient air temperatures. This procedure offers a method for interpreting water balance estimates of soil moisture deficit and advance forecasts of daily maximum air temperatures for need of irrigation. (Skogerboe-Colorado State)  
W76-13024

**WELL CUTTINGS ANALYSIS IN GROUND-WATER RESOURCES EVALUATION,**  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
For primary bibliographic entry see Field 8G.  
W76-13036

**IDENTIFICATION AND NATURE OF DISPERSIVE SOILS,**  
Soil Conservation Service, Lincoln, Nebr.  
For primary bibliographic entry see Field 8D.  
W76-13170

**PORE-WATER PRESSURE CHANGES DURING SOIL LIQUIFACTION,**  
California Univ., Berkeley. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 8D.  
W76-13171

**RESULTS OF SOIL MOISTURE FLIGHTS DURING APRIL 1974,**  
National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.  
T. J. Schmugge, B. J. Blanchard, W. J. Burke, J. F. Paris, and J. R. Wang.  
Report No. TN D-8199, May 1976. 55 p, 7 fig, 6 tab, 11 ref, 2 append.

Descriptors: \*Remote sensing, \*Soil moisture, \*Microwaves, \*Aircraft, \*Arizona, Instrumentation, Measurement, Surveys, Equations, Radiation, Infrared radiation, Temperature, Soil temperature, Irrigation, On-site investigations.  
Identifiers: Radiometers.

The results presented were derived from measurements made during the April 5 and 6, 1974 flights of the NASA P-3A aircraft over the Phoenix, Arizona agricultural test site. The purpose of the mission was to study the use of microwave techniques for the remote sensing of soil moisture. These results included infrared (10- to 12-micrometers) 2.8-cm and 21-cm brightness temperatures for approximately 90 bare fields. These brightness temperatures were compared with surface measurements of the soil moisture made at the time of the overflights. These data indicated that the combination of the sum and difference of the vertically and the horizontally polarized brightness temperatures yield information on both the soil moisture and surface roughness conditions. (Sims-ISWS)  
W76-13178

## 2H. Lakes

**BLUFF EROSION, RECESSION RATES, AND VOLUMETRIC LOSSES ON THE LAKE MICHIGAN SHORE IN ILLINOIS,**  
Illinois State Geological Survey, Urbana.  
For primary bibliographic entry see Field 2J.  
W76-12686

**SURVEY FOR RADIOACTIVITY IN A SWAMP,**  
Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Plant.  
For primary bibliographic entry see Field 5C.  
W76-12689

**ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION, VOLUME 3. CHEMISTRY OF LAKE MICHIGAN,**  
Wisconsin Univ., Madison. Water Chemistry Lab.  
For primary bibliographic entry see Field 5C.  
W76-12695

**OSMOREGULATION IN TRICHOCORIXA VERTICALIS INTERIORES SAILER (HEMIPTERA, CORIXIDAE) - AN INHABITANT OF SASKATCHEWAN SALINE LAKES, CANADA,**  
Saskatchewan Univ., Saskatoon. Dept. of Biology.  
For primary bibliographic entry see Field 5C.  
W76-12733

**CESIUM 137 ACTIVITIES IN FISH RESIDING IN THERMAL DISCHARGES TO LAKE MICHIGAN,**  
Argonne National Lab., Ill. Radiological and Environmental Research Div.  
For primary bibliographic entry see Field 5C.  
W76-12738

**FACTORS CONTROLLING RATES OF METHANE OXIDATION AND THE DISTRIBUTION OF THE METHANE OXIDIZERS IN A SMALL STRATIFIED LAKE,**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.  
For primary bibliographic entry see Field 5B.  
W76-12750

**FEEDING CHARACTERISTICS AND PREDATION IMPACT OF CHAOBORUS (DIPTERA, CHAOBORIDAE) LARVAE IN A SMALL LAKE,**  
Toronto Univ. (Ontario). Inst. for Environmental Studies and Engineering.  
A. Y. Fedorenko.  
Limnology and Oceanography, Vol. 20, No. 2, March 1975. p 250-258, 11 ref, 7 fig.

Descriptors: \*Ecology, \*Predation, \*Feeding rate, Temperature, Larvae, Size, Diel migration, \*Diptera, Lakes, Behavior, Food habits.  
Identifiers: \*Chaoborus.

Data showed that, in general, feeding rates of *C. americanus* and *C. trivittatus* larvae increased with temperature, prey density and larval size and varied with prey type. Old fourth instar *C. trivittatus* larvae showed no change in feeding rates with temperature change. It was concluded that, since these larvae undergo extensive diel vertical migrations into the cold, food-poor hypolimnion, the maintenance of a relatively high feeding rate despite cold temperatures would be advantageous. Remaining larvae migrate less extensively and their feeding rates decline sharply as temperature falls. An absence of any pattern in day-to-day food intake by larvae held in the laboratory was noted. Estimated mean percentage of standing crop of prey eaten by *Chaoborus* was: 2% for copepod nauplii, 3% for *Daphnia* tyrelli, 9% for *Daphnia* kenai, and 4% for *Diaphanosoma*. Seasonal and spatial segregation and size incompatibility of predator and prey influenced *Chaoborus* predation. (Chilton-ORNL)  
W76-12752

**SPAWNING OF LAKE WHITEFISH, COREGONUS CLUPEAIFORMIS, AND ROUND WHITEFISH, PROSOPIUM CYLINDRACEUM, IN AISHIHIK LAKE AND EAST AISHIHIK RIVER, YUKON TERRITORY,**  
Fisheries and Marine Service, Vancouver (British Columbia). Vancouver Lab.  
J. E. Bryan, and D. A. Kato.  
Journal of the Fisheries Research Board of Canada, Vol. 32, No. 2, 1975, p 283-288, 2 fig, 2 tab, 17 ref.

Descriptors: \*Ecology, \*Reproduction, \*Spawning, Eggs, Freshwater fish, Lakes, Rivers, \*Canada.  
Identifiers: \*Aishihik Lake (YT), East Aishihik River (YT), \*Whitefish, Lake whitefish, Round whitefish.

The study resulted from the discovery of spawning grounds of lake and round whitefish during an impact study of hydroelectric development. Results of the investigations showed that lake whitefish spawned over silt and Potamogeton in water 2.0-2.5 m deep where there was little current and that the spawning period lasted from early November to mid-December. Spawning round whitefish appeared to have been completed by November. Although round whitefish spawned in a range of habitats (silt, Potamogeton, in fast and slow current and depths from 0.7 to 2.5m) eggs were most often found on gravel in fast currents at depths of less than 1 m. (Chilton-ORNL)  
W76-12754

**NEARSHORE CURRENTS AT POINT BEACH, WISCONSIN (1974-1975),**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 7B.  
W76-12758

**PERIPHYTON CROPS AND PRODUCTIVITY IN A REACTOR THERMAL EFFLUENT,**  
Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.  
For primary bibliographic entry see Field 5C.  
W76-12762

**MEASUREMENTS OF PHYSICAL PHENOMENA RELATED TO POWER PLANT WASTE HEAT DISCHARGES: LAKE MICHIGAN, 1973 AND 1974,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12770

**THERMAL PLUME MAPPING,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12771

**MEASUREMENTS OF EDDY DIFFUSIVITIES IN NEARSHORE REGIONS OF LAKE MICHIGAN,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12772

**A COMPARISON OF AERIAL INFRARED AND BOAT ORIENTED THERMAL PLUME MEASUREMENT TECHNIQUES,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12773

**NEAR SHORE LAKE CURRENT INVESTIGATIONS,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12774

**FIELD OBSERVATION OF THE DYNAMICS OF HEATED DISCHARGE JETS,**  
Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12775

**SITE AND DESIGN TEMPERATURE RELATED ECONOMICS OF NUCLEAR POWER PLANTS WITH EVAPORATIVE AND NON-EVAPORATIVE COOLING TOWER SYSTEMS,**  
Gilbert Associates, Inc. Reading, Pa.

For primary bibliographic entry see Field 6G.  
W76-12784

**MAP SHOWING LAKES IN THE GREATER DENVER AREA FRONT RANGE URBAN CORRIDOR, COLORADO,**

Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 7C.

W76-12795

**LAKES IN THE COLORADO SPRINGS—CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**

Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 7C.

W76-12797

**DATA ON SELECTED LAKES IN WASHINGTON, PART 4,**

Geological Survey, Tucson, Ariz.

For primary bibliographic entry see Field 7C.

W76-12808

**GREAT LAKES RESEARCH DIVISION, CHRONOLOGY OF RESEARCH: 1950 TO THE PRESENT.**

Michigan Univ., Ann Arbor. Great Lakes Research Div.  
1975. 58 p.

Descriptors: \*Great Lakes, \*Research facilities, \*Projects, \*Michigan, Water balance, Lakes, \*History, Water quality, Water circulation, Air-water interfaces, Meteorology, Ice cover, Climate, Erosion, Sedimentation, Basins, Biology, Biological communities, Engineering.

This chronology of the research of the Great Lakes Research Division is fundamentally a history of the works of the Division and its predecessor, the Great Lakes Research Institute. It was designed to function primarily as an internal record, summary, and review of the Division's past and present research activities and publications, but experience had shown that it (together with other Division brochures) is useful to others who seek information about the Division. The chronology showed, year by year, the research projects held by the Division. The title of each project first appeared under the year in which it was granted; renewed projects were indicated as continuations and referred back to the initial year where a brief project description is given. Each project was, in its first appearance, back-referred to the Research Areas section to show its areas of relevance. For the convenience of the reader, all publications from a project were listed under the first year of the project regardless of the year of publication. The Chronology of Research was followed by an Index of Projects by Problem Areas for the reader's convenience in locating project descriptions and publications. Lists of the serially numbered Publications, Contributions, and Special Reports of the Division concluded this booklet. (Sims-ISWS)  
W76-12815

**REMOTE SENSING STUDY OF MAUMEE RIVER EFFECTS ON LAKE ERIE,**

National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.

For primary bibliographic entry see Field 5A.

W76-12819

**COMPARISON OF REQUIRED RESERVOIR STORAGES COMPUTED BY THE THOMAS-FIERING MODEL AND THE 'KARLSRUHE MODEL' TYPE A AND B,**

Karlsruhe Univ. (West Germany). Institut fuer Wasserbau III.

For primary bibliographic entry see Field 4A.

W76-12832

**WAVE-INDUCED MASS TRANSPORT IN**

**WATER WAVES,**

Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. Marine Studies.

R. A. Dalrymple.

Journal of the Waterways, Harbors and Coastal Engineering Division, American Society of Civil Engineers, Vol. 102, No. WW2, Proceedings Paper 12158, p 255-264, May 1976. 7 fig, 2 tab, 13 ref, 2 append.

Descriptors: \*Hydrodynamics, \*Flow profiles, \*Waves(Water), Coastal engineering, Currents(Water), Velocity, Theoretical analysis, Equations, Mathematical studies, Viscosity, Shear.

Identifiers: \*Mass transport, \*Wave-current interaction, Wave energy, Velocity distribution, Eulerian mass transport distribution.

The Eulerian mass transport under water waves was studied for an inviscid fluid using finite amplitude wave theories. The distribution of the transport over the water depth for example waves was shown to be confined to a region above the wave trough and to be of lesser magnitude than predicted by Airy wave theory. A measured mean velocity was defined to examine the effect of time-averaging over the duration of immersion, and its variation over the water column was shown. Finally, the presence of a linear shear current in the direction of the wave was shown to alter the total mass transport principally by superposition. (Adams-ISWS)  
W76-12844

**POLLUTANT AEROSOL DEPOSITION INTO SOUTHERN LAKE MICHIGAN,**

Illinois State Water Survey, Urbana. Atmospheric Sciences Section.

For primary bibliographic entry see Field 5B.

W76-12935

**LAKE GEORGE SITE SYNTHESIS, 1974-1975.**

Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst.

For primary bibliographic entry see Field 5C.

W76-12937

**FLUCTUATIONS OF PHYTOPLANKTON BIOMASS AND ITS COMPOSITION IN A SUB-ARCTIC LAKE DURING SUMMER,**

Toronto Univ. (Ontario). Dept. of Botany.

For primary bibliographic entry see Field 5C.

W76-12938

**WATER QUALITY INVESTIGATIONS IN A SMALL ARTIFICIAL RESERVOIR,**

Arkansas Dept. of Commerce, Little Rock. Div. of Soil and Water Resources.

For primary bibliographic entry see Field 5C.

W76-12943

**SOME ECOLOGICAL ASPECTS OF THE CABORA BASSA DAM,**

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.

For primary bibliographic entry see Field 6G.

W76-12945

**IMPACTS OF RECREATIONAL DEVELOPMENT: THE VOYAGER VILLAGE EXPERIENCE,**

Wisconsin Planning Office, Madison.

For primary bibliographic entry see Field 6B.

W76-12965

**EMISSION OF SULFUR FROM LAKE ONTARIO SEDIMENTS,**

Canada Centre for Inland Waters, Burlington (Ontario).

For primary bibliographic entry see Field 2J.

W76-12987

**THERMAL LOADING OF HYCO LAKE, NORTH CAROLINA-- THE EFFECT OF HEATED WATER ON TEMPERATURE AND EVAPORATION, 1966-74,**

Geological Survey, Raleigh, N. C.

For primary bibliographic entry see Field 5C.

W76-13078

**SUBLACUSTRINE FAN MORPHOLOGY IN LAKE SUPERIOR,**

Geological Survey, Menlo Park, Calif.

For primary bibliographic entry see Field 5B.

W76-13079

**INPUTS OF PHOSPHORUS FROM PRECIPITATION TO LAKE MICHIGAN,**

DePaul Univ., Chicago, Ill.

For primary bibliographic entry see Field 5B.

W76-13112

**EFFECTS OF CHLORINE AND SULFITE REDUCTION ON LAKE MICHIGAN INVERTEBRATES,**

Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.

For primary bibliographic entry see Field 5C.

W76-13113

**PHYSIOLOGICAL CHANGES DURING THE COURSE OF BLOOMS OF APHANIZOMENON FLOS-AQUAE,**

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.

For primary bibliographic entry see Field 5C.

W76-13114

**POSSIBLE EFFECT OF LOWER PHOSPHORUS CONCENTRATIONS ON THE PHYTOPLANKTON IN ONONDAGA LAKE, NEW YORK, U.S.A.,**

State Univ. of New York at Buffalo. Dept. of Biology.

For primary bibliographic entry see Field 5C.

W76-13116

**DYNAMICS OF NUMBER AND BIOMASS OF PLANKTONIC INFUSORIA IN OPEN ZONES OF KREMENCHUG RESERVOIR AND THEIR PRODUCTION AND ROLE IN ORGANIC MATTER DESTRUCTION, (IN RUSSIAN),**

Akademiya Nauk URSS, Kiev. Instytut Hidrobiologii.

A. A. Nebrat.

Gidrobiol Zh. 11(2), p 18-27, 1975.

Descriptors: \*Plankton, \*Biomass, Population, Fish populations, \*Organic matter, \*Waste assimilative capacity, \*Reservoirs.

Identifiers: \*Infusoria, Kremenchug Reservoir, Strombidium-gyrans, Strombidium-viride, Tintinnidium-fluviatile, Ukrainian-SSR, USSR.

Seasonal dynamics of infusoria (dominant species: Tintinnidium fluviatile, Strombidium viride, S. gyrans) numbers and biomass and their horizontal distribution and variation in the species composition were studied during the vegetation period of 1972. The Infusoria production for the vegetation period was 39.43 g/m<sup>3</sup> (236.6g/2); the average monthly P/B (production/biomass) coefficient, 23. Destruction of organic matter resulting from respiration was equal on the average to 38.6 mg of dry organic matter/1 m<sup>3</sup> of water for 24 h, or 7.98 g/m<sup>3</sup> of dry (39.9 g/m<sup>3</sup> of green) organic matter for the vegetation period (Ukrainian SSR, USSR).—Copyright 1976, Biological Abstracts, Inc.  
W76-13141

## Field 2—WATER CYCLE

### Group 2H—Lakes

**CHARACTERISTICS OF THE PRIMARY PRODUCTION IN THE SALMON BREEDING LAKE, (IN RUSSIAN),** Akademiya Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod. For primary bibliographic entry see Field 5C. W76-13193

**QUANTITATIVE DYNAMICS OF BACTERIA IN THE KREMENCHUG RESERVOIR, (IN RUSSIAN),** Akademiya Nauk URSR, Kiev. Instytut Hidrobiologii. For primary bibliographic entry see Field 5C. W76-13195

**ZOOPLANKTON POPULATIONS IN THE 'WATER-SPORTBAAN GEORGES NACHEZ' AT GHENT IN 1972, A YEAR OF CONTINUOUS WATERBLOOMING, (IN FLEMISH),** Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwetenschappen. For primary bibliographic entry see Field 5C. W76-13196

## 2L. Water In Plants

**COMPARATIVE STUDIES OF PLANT GROWTH AND DISTRIBUTION IN RELATION TO WATERLOGGING: VII. THE INFLUENCE OF WATER-TABLE FLUCTUATIONS ON IRON AND MANGANESE AVAILABILITY IN DUNE SLACK SOILS,** Trent Univ., Peterborough (Ontario). Dept. of Biology. R. Jones. J Ecol. 61(1), p 107-116, 1973.

Descriptors: \*Plant growth, \*Distribution, \*Iron, \*Manganese, Seasonal, Soils, Dunes, Water level fluctuation, \*Organic matter, Soil profiles. Identifiers: Agrostis-Sp, Carex-Sp, Equisetum-Sp, \*Waterlogging, Watertable.

The possibility that a seasonal trend, associated with flooding, of available Fe and Mn occurred in dune slack soils was investigated. It was found that availability increased when soils were flooded in winter and spring, was highest in early summer, and that it declined with the falling water-tables in late summer. High organic matter content of dune slack soils was associated with high concentrations of available Fe and Mn. The exchangeable iron and manganese content of the soil profile decreased with depth at each of the 3 sites studied (Carex, Agrostis and Equisetum dominants, respectively (Great Britain), corresponding with the decreasing organic matter content down the profile. Total Fe and Mn were greatest in the surface layers, probably as a result of precipitation and the higher organic matter content. The possible effect of Fe and Mn availability on the distribution of dune slack plants is discussed. (See also W72-14874, W73-09063, and W73-09064).—Copyright 1974, Biological Abstracts, Inc. W76-12708

**ENVIRONMENTAL AND CULTURAL PRECONDITIONING EFFECTS ON THE WATER USE RATE OF AGROSTIS PALUSTRIS HUDS., CULTIVAR PENNCROSS,** Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences. R. C. Shearman, and J. B. Beard. Crop Sci. 13(4), p 424-427, 1973.

Descriptors: \*Light intensity, \*Water temperature, Irrigation, \*Nitrogen, Nutrients, \*Stomata, Absorption. Identifiers: \*Agrostis-Palustris, Cultivars, Penn-cross.

Preconditioning effects of light intensity, growing temperature, irrigation frequency, cutting height, mowing frequency, and N nutrition level on water use rate and stomatal density of 'Penn-cross' creeping bentgrass (A. Palustris) were investigated. Water use rates were recorded as percent moisture lost during exposure to 33C 40% relative humidity, 4300-lux light intensity, and a constant airflow of 186 cm/sec in a special wind tunnel apparatus. Stomatal density counts were made at 430X from the nitrocellulose replications of the leaf surface. The preconditioning effects of cutting height, light intensity, and N nutrition level had the greatest influence on water use rate. Irrigation and mowing frequency were intermediate in their influence. Growing temperature had the least effect among the factors considered. Stomatal density was influenced most by light intensity, and growing temperature had the next greatest effect. Irrigation frequency had an intermediate effect. N nutrition level had the least influence of the factors studied. Water use rate was positively correlated ( $r = 0.88$ ) to stomatal density in the light intensity study. However, it was negatively correlated ( $r = -0.98$ ) to stomatal density for the N nutrition level study. No significant correlations were observed for growing temperature or irrigation frequency.—Copyright 1974, Biological Abstracts, Inc. W76-12723

**FINITE DIFFERENCE AND FINITE ELEMENT SIMULATION OF FIELD WATER UPTAKE BY PLANTS,** Institute for Land and Water Management Research, Wageningen (Netherlands). For primary bibliographic entry see Field 2G. W76-12830

**STUDIES ON HELMINTHS OF NORTH DAKOTA: V. LIFE HISTORY OF PHYLLODISTOMUM NOCOMIS FISCHTHAL, 1942 (TREMATODA:GORGODERIDAE),** Nebraska Univ., Lincoln. Dept. of Zoology. W. W. Wanson, and O. R. Larson. J Parasitol. 58(6), p 1106-1109, 1972.

Descriptors: \*North Dakota, History, \*Trematodes, Clams, \*Worms, \*Parasites. Identifiers: \*Gorgoderidae, \*Helmiths, Hybopsis-Biguttata, Notropis-Cornutus, Phyllostomum-Nocomis, Rhinichthys-Cataractae, Semotilus-Atramaculatus, Sphaerium-Striatum, \*Forest River(ND), Hornyhead chubs.

Sporocysts and cercariae from Forest River, North Dakota, develop inside the gills of the finngail clam, Sphaerium striatum, and cercariae encyst within their daughter spocysts. Metacercariae fed to 4 spp. of minnows (Hybopsis biguttata, Semotilus atramaculatus, Notropis cornutus, Rhinichthys cataractae) were recovered as immature worms from kidney ducts and urinary bladders of all 4 spp. Only in hornyhead chubs (H. biguttata) did worms mature into egg-bearing adults. The definitive host acquires the parasite by eating infected clams.—Copyright 1973, Biological Abstracts, Inc. W76-12912

**EFFECT OF SUSPENDED COAL PARTICLES ON LIFE FORMS OF AQUATIC MOSS EURHYNCIUM RIPARIOIDES (HEDW): II. THE EFFECT ON SPORE GERMINATION AND REGENERATION OF APICAL TIPS,** University Coll., Cardiff (Wales). Dept. of Botany. For primary bibliographic entry see Field 5C. W76-12913

**UTILIZATION OF PETROLEUM YEAST IN FISH FEED: II. EFFECT ON GROWTH AND BODY LIPIDS OF RAINBOW TROUT FIN-**

**GERLINGS RAISED IN CAGES, (IN JAPANESE),** Freshwater Fisheries Research Lab., Tokyo (Japan). Y. Shimma, and N. Makoto. Bull Freshwater Fish Res Lab (Tokyo) 24(2), p 111-119, 1974.

Descriptors: \*Fish food organisms, Fish, \*Growth rates, \*Rainbow trout, Lipids, Yeasts, Soybeans, Fry, \*Fish diets. Identifiers: \*Petroleum yeasts, Liver lipids, Fish cages, Cholesterol.

The growth rate of rainbow trout fingerlings raised in small aquaria in previous research was low. Another feeding test was conducted in 0.2-m<sup>3</sup> cages set in a raceway for 42 days and a succeeding 26 days. Test diets were fed to fish on a schedule. After the test periods liver and carcass lipids were extracted and analyzed for cholesterol content and fatty acid composition. Average daily growth rates with fish meal were 3.1% (former period) and 2.5-2.7% (latter period). Petroleum yeast lots showed a lower growth rate and feed efficiency than fish meal lots in the former period, but results as good as those of the meal lots in the latter period. Although addition of 3% grease softened the pellets feeding results of the grease-supplemented petroleum yeast pellets were inferior to those of the non-supplemented pellets. Yeast from the drainage of soybean cookers contained 45.7% crude protein. Combined feeding of the yeast resulted in good fish growth but the lowest feed efficiency among the test diets. The fatty acid pattern of petroleum yeast which contained appreciable odd-number fatty acids was reflected more distinctly in carcass lipids than in liver lipids. Liver lipids from fish fed with diets containing 65% fish meal or 3% grease had markedly higher contents of cholesterol than those from fish fed SCP diets or non-grease diets.—Copyright 1976, Biological Abstracts, Inc. W76-12960

**LEAF WATER POTENTIAL AND MOISTURE BALANCE—FIELD DATA,** Agricultural Research Service, Auburn, Ala.; and Alabama Agricultural Experiment Station, Auburn. M. G. Huck, V. D. Browning, and R. E. Young. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 15 p, 6 fig, 2 tab, 13 ref. ASAE Paper 75-2582.

Descriptors: \*Root development, \*Root distribution, \*Root system, Soil moisture, Soil water, Soil-water-plant relationships, Irrigation, Irrigation practices, Transpiration. Identifiers: \*Leaf water potential.

The experimental hypothesis that increased root growth in a larger soil reservoir will make additional water available to the plant was tested and largely proved to be true. However, the corollary, based on a suggestion that increased water potential will permit a more rapid growth of cotton plants, has been cast into serious doubt. If the osmotic component of leaf water potential is neglected, the accumulated data from 3 years of field experiments strongly suggest that plants growing under these conditions have a slightly lower leaf water potential when the availability of additional soil water permits growth of a larger plant with a higher transpirational demand. (Skogerboe - Colorado State) W76-13011

**PLANT WATER STRESS CRITERIA FOR IRRIGATION SCHEDULING,** North Dakota State Univ., Fargo. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2G. W76-13024



**A SECOND LOCALITY FOR NATIVE CALIFORNIA FAN PALMS (WASHINGTONIA FILIFERS) IN ARIZONA**, Geological Survey, Tucson, Ariz. D. E. Brown, N. B. Carmony, C. H. Lowe, and R. M. Turner. Reprint from Arizona Academy of Science, Vol. 11, No. 1, p. 37-41, February 1976. 5 fig, 1 tab, 53 ref.

Descriptors: \*Vegetation, \*Arid lands, \*Arizona, \*Riparian plants, Springs, Moisture, Arroyos, Ecological distribution, Phreatophytes, Desert plants. Identifiers: \*Washingtonia filifera, \*Fan palms, Oasis vegetation, Sonoran Desert.

Three groves of the California fan palm (*Washingtonia filifera* Wendl.) located in southern Yavapai County, Arizona, are described and reasons presented for considering the groves native. The groves occur near Castle Creek and represent only the second known locality for the species in Arizona. The other locality, in the Kofa Mountains, lies 185 km (115 mi) to the southwest. Thus the Castle Creek groves represent a significant range extension for the species. A map of the known distribution of the palm is presented. (Woodard-USGS) W76-13069

**PHYSIOLOGICAL CHANGES DURING THE COURSE OF BLOOMS OF APHANIZOMENON FLOS-AQUAE**, Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst. For primary bibliographic entry see Field 5C. W76-13114

**DROUGHT RESISTANCE OF BLUE GRAMA AS AFFECTED BY ATRAZINE AND N. FERTILIZER**, Agricultural Research Service, Fort Collins, Colo. D. N. Hyder, W. R. Houston, and J. B. Burwell. Journal of Range Management, Vol. 29, No. 3, p. 214-216, May 1976. 5 fig, 11 ref.

Descriptors: \*Drought resistance, \*Grama grasses, \*Nitrogen, \*Crop response, Soil-water-plant relationships, Fertilizers, Range grasses, \*Colorado, \*Forage grasses. Identifiers: \*Atrazine, Blue gramma, Central Plains Experimental Range(Colo).

A study of blue grama (*Bouteloua gracilis*) drought resistance was conducted during two consecutive summer droughts at the Central Plains Experimental Range in north central Colorado. Considerable thinning of blue gramma stands (from a frequency of 85% in 1970 to 56% in 1973) due to drought conditions was increased by applicatrazine must reduce drought severity by the net effects of weed control and/or reduced transpiration. Further investigation of atrazine's effect is underway. (Jahns-Arizona) W76-13122

**DYNAMICS OF THE ROOT SYSTEM OF BLUE GRAMA**, ALVAR Aluminio Argentina, Cangallo. Area Investigacion y Desarrollo. J. Ares. Journal of Range Management, Vol. 29, No. 3, p. 208-213, May 1976. 5 tab, 6 fig, 11 ref.

Descriptors: \*Root systems, \*Root development, \*Grama grasses, \*Soil-water-plant relationships, Soil water, Water requirements, Plant physiology, Water utilization, Root zone, \*Colorado, \*Forage grasses. Identifiers: \*Blue grama, US/IBP Pawnee Site (Colorado).

Field experiments with blue grama (*Bouteloua gracilis*) were conducted during the 1973 growing

season at the US/IBP Pawnee Site in northern Colorado using root observation windows to record root differentiation and growth. Roots began to grow and differentiate shortly before leaf growth was evident. Soil desiccation in mid-growing season caused death and decomposition of 30 to 60% of the newly formed roots. Roots are transient, and their functional development parallels the degree of suberization, with young nonsuberized roots concentrated in soil profile regions where the soil water potential was high to handle water uptake. There was massive root growth near the end of the growing season when soil water potential was high. Root growth late in the season was greatest near the plant's crown, which caused increased root biomass in upper levels of the soil profile as the season progressed. An empirical equation for root growth and development is presented. (Jahns-Arizona) W76-13123

**WATER USE BY DRYLAND CORN AS AFFECTED BY MATURITY CLASS AND PLANT SPACING**, Agricultural Research Service, Mandan, N. D. Northern Great Plains Research Center. For primary bibliographic entry see Field 3F. W76-13124

**WATER ECONOMY AND DRINKING REGIME OF THE BEDOUIN GOAT**, Tel-Aviv Univ. (Israel). Dept. of Zoology. For primary bibliographic entry see Field 3C. W76-13125

**PLANT SURVIVAL IN THE ARID SOUTHWEST 30 YEARS AFTER SEEDING**, Arizona State Univ., Tempe. For primary bibliographic entry see Field 4A. W76-13128

**GENOTYPE VARIATION IN NUTRIENT UPTAKE EFFICIENCY IN CORN**, New York State Univ. Agriculture and Technology Coll. at Cobleskill. For primary bibliographic entry see Field 3F. W76-13134

**COMPARATIVE ESTIMATION OF THE ROLE OF DETRITUS AND ALGAE IN NEOMYSIS MIRABILIS (CZERNIAVSKY) NUTRITION, (IN RUSSIAN)**, Institute of Biology of the Southern Seas, Sevastopol (USSR). G. A. Pechen'-Finenko, and T. V. Pavlovskaya. Gidrobiol Zh. 11(2), p. 39-44, 1975.

Descriptors: Analytical techniques, \*Algae, Diurnal, \*Detritus, Waste assimilative capacity, Aquatic animals, Carbon radioisotopes, Estimating, Aquatic plants. Identifiers: \*Gymnodinium-kowalevskii, \*Gymnodinium-spp., \*Neomysis-mirabilis, Peridinae, \*Radiocarbon method.

The efficiency of the nutrition of *N. mirabilis* on vegetative and animal detritus, melanin and living Peridinae algae was determined by the radiocarbon method. The diurnal value of the 'index of filling' of 4 suggested foods was highest for the living algae *Gymnodinium kowalevskii*; animal detritus was consumed more effectively than vegetative detritus. The diurnal ration value of the animals with an excess *Gymnodinium* concentration was 15.7 and 30 times as high as detritus and melanin diurnal rations. Balance experiments concerning the dependence of algae consumption and assimilation on concentration, showed that only the highest of the suggested concentrations (1.6 mg/l of green weight) can meet the food requirements of *N. mirabilis*.—Copyright 1976, Biological Abstracts, Inc. W76-13149

## 2J. Erosion and Sedimentation

**BLUFF EROSION, RECESSION RATES, AND VOLUMETRIC LOSSES ON THE LAKE MICHIGAN SHORE IN ILLINOIS**, Illinois State Geological Survey, Urbana. R. C. Berg, and C. Collinson. Environmental Geology Notes, Report EGN 76, No. 76, July 1976, 33 p, 19 fig, 10 tab, 14 ref.

Descriptors: \*Erosion, \*Erosion rates, Bank erosion, \*Lake Michigan, \*Lake shores, Shore protection, Littoral drift, Sediments, Shoreline cover, Geology, Groundwater, \*Illinois.

Significant bluff erosion is apparent at more than 21 sites on the Illinois shore of Lake Michigan between Winnetka and Waukegan. The Lake Bluff shore was studied in some detail to determine what characteristics contribute to its instability and recession. It was concluded that the recession can be attributed to high lake levels bluff denudation, inadequate shore protection, weakness of earth materials in the bluffs, oversteep slopes, excessive water pressure affecting groundwater quantity and gradient, surface drainage and seepage, and lack of littoral drift sediments and the resultant absence of protective beaches. (Chilton-ORNL) W76-12686

**A BRIEF HYDROLOGIC APPRAISAL OF THE JULY 3-4, 1975, FLASH FLOOD IN LAS VEGAS VALLEY, NEVADA**, Geological Survey, Carson City, Nev. For primary bibliographic entry see Field 4A. W76-12806

**BEACH DYNAMICS AND NEARSHORE MORPHOLOGY OF THE BEAUFORT SEA COAST, ALASKA**, Arctic Inst. of North America, Arlington, Va. For primary bibliographic entry see Field 2L. W76-12820

**EROSION AND TRANSPORT OF BED-LOAD SEDIMENT**, Koninklijke Shell Exploratie en Productie Laboratorium, Rijswijk (Netherlands). R. F. Luque, and R. van Beek. Journal of Hydraulic Research, Vol. 14, No. 2, p. 127-144, 1976. 10 fig, 15 ref.

Descriptors: \*Bed load, \*Erosion, \*Sediment transport, Deposition(Sediments), Saltation, Sands, Gravels, Hydraulics, Equations, Mathematical studies, Laboratory tests, Scour. Identifiers: \*Mean critical shear stress, \*Non-ceasing scour, Average particle velocity, Shield grain-movement condition, Magnetite grain, Walnut grain.

Results of a series of experiments were presented in which were measured: the mean critical bed shear stress at SHIELDS' grain-movement condition and at the initiation of non-ceasing scour, the rate of bedload transport, the average particle velocity, the rate of deposition, and the average length of individual steps of saltating bed-load particles, in water, as a function of the time-mean bed shear stress. These experiments were performed in a closed rectangular flow channel at different slopes of the bed surface and using five different bed materials (two sands, gravel, magnetite and walnut grains). A comparison of the threshold drag acting at different downward slopes of the bed surface (0, 12, 18 and 22 degrees) resulted in a surprisingly large critical-drag angle of 47 degrees. The initiation of non-ceasing scour of a loose granular bed was studied experimentally behind a consolidated bed of the same material as the loose bed. The corresponding instantaneous threshold drag was about three times larger than the threshold drag acting at SHIELDS' grain movement condition. The rate of bed-load transport

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measured as a function of the mean bed-shear stress satisfied a generalized MEYER-PETER and MULLER formula (1948), also at various downward slopes of the bed surface, as investigated up to 22 degrees. The rate of particle deposition was found to be proportional to the rate of bed-load transport, and the average length of individual particle steps was found to be a constant. This implied that the probability of a bed-load particle being deposited when striking the bed surface is independent of the flow rate within the experimental range. This result contradicted EINSTEIN'S theory of bed-load transport (1950). (Lee-ISWS)  
W76-12827

**NEW DIVER-OPERATED BEDLOAD SAMPLER.**  
Georgia Inst. of Tech., Atlanta. Dept. of Geophysical Science.  
D. G. Waslenchuk.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY6, Proceedings Paper 12179, p 747-757, June 1976. 1 fig, 4 tab, 8 ref, 2 append.

Descriptors: \*Bed load, \*Channels, \*Bed load samplers, \*Sampling, \*Sediment discharge, \*Streams, \*Scuba diving, \*Sands, \*Equation, \*Instrumentation, \*On-site investigations.  
Identifiers: \*Diver-operated samplers.

The paper described a scuba-diver operated sampler for the measurement of bedload discharge in any stream. This was a portable pit type sampler which was pushed into the riverbed by a diver. Sediment particles were deposited in the sampler as they were transported over the leading edge of the wedge-shaped cavity. The sampler opening was adjustable in size. In the testing, the sampler performed well compared to the dune-tracking method of bedload sampling. (Bhowmik-ISWS)  
W76-12972

**EMISSION OF SULFUR FROM LAKE ONTARIO SEDIMENTS.**  
Canada Centre for Inland Waters, Burlington (Ontario).  
J. O. Nriagu, and R. D. Coker.  
Limnology and Oceanography, Vol. 21, No. 4, p 485-489, July 1976. 1 fig, 1 tab, 21 ref.

Descriptors: Sulfur, \*Sulfur compounds, \*Lake Ontario, \*Lake sediments, \*Sediments, \*Great Lakes, \*Hydrogen sulfide, \*Analytical techniques, \*Inorganic compounds, \*Water quality, \*Surface waters, \*Lakes, \*Bottom sediments, \*Analysis, \*Chemistry, \*Mass spectrometry, \*Instrumentation, \*Equations, \*Mathematical studies.  
Identifiers: \*Sulfur emissions (Sediments), \*Lake Ontario sediments, \*Lake Ontario basin, \*Volatile sulfur compounds, \*Sulfur cycle, \*Lacustrine sediments, \*Benthos corer, \*Analytical methods, \*Analytical procedures, \*Isotope-ratio mass spectrometer, Sulfur 32, Sulfur 34, \*Elemental sulfur, Sulfur release.

Calculations indicated that about 600,000 kg of sulfur is released annually from Lake Ontario sediments. It was concluded that this constitutes about 1 percent of the annual sulfur input into the sediments and is insignificant compared to the total sulfur that cycles annually through the lake. Also, the sulfur released from the sediments is enriched in S32 with the result that the sulfur in the historical layers is characterized by high delta S34 values. (Henley-ISWS)  
W76-12987

**CHANGES OCCURRING IN THE OCEANIC PORTION OF THE COLVILLE RIVER DELTA, ALASKA, DURING SPRING FLOODING.**  
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology; and Louisiana State Univ., Baton Rouge. Coastal Studies Inst.  
For primary bibliographic entry see Field 2C.

W76-12997

**SEDIMENT FROM DRAINAGE SYSTEMS FOR A HEAVY SOIL.**  
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W76-13001

**PHYSICAL-CHEMICAL COMPOSITION OF ERODED SOIL.**  
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.  
E. J. Monke, H. J. Marelli, L. D. Meyer, and J. F. DeJong.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 11 p, 3 fig, 5 tab, 7 ref. ASAE Paper 75-2584.

Descriptors: \*Runoff, \*Particle size, \*Erosion, \*Erosion rates, \*Soil tests, \*Soil investigations, \*Soil erosion, \*Soil properties, \*Water quality, \*Cultivation, \*Simulated rainfall, \*Pollutant identification, \*Water loss, \*Indiana.  
Identifiers: \*Maumee River basin (Ind).

Water loss by runoff, soil loss in runoff, particle size distribution in the eroded soil material, and the water quality of runoff containing eroded soil materials were measured from soil surfaces subjected to simulated rainfall. Three soils from the Maumee River Basin under two extreme till conditions were selected. (Skogerboe - Colorado State)  
W76-13010

**VARIATION OF SUSPENDED SEDIMENT LOAD IN THE PALOUSE REGION OF THE NORTHWEST.**  
For primary bibliographic entry see Field 5G.  
W76-13012

**SUSPENDED SEDIMENT AND TURBIDITY IN IRRIGATION RETURN FLOWS - A PROTOTYPE STUDY.**  
Soil Conservation Service, Spokane, Wash.  
For primary bibliographic entry see Field 5B.  
W76-13017

**SUBLACUSTRINE FAN MORPHOLOGY IN LAKE SUPERIOR.**  
Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 5B.  
W76-13079

**TECHNIQUES IN EVALUATING SUITABILITY OF BORROW MATERIAL FOR BEACH NOURISHMENT.**  
Coastal Engineering Research Center, Fort Belvoir, Va.  
For primary bibliographic entry see Field 8B.  
W76-13175

## 2K. Chemical Processes

**GROUND-WATER BASIC DATA FOR DUNN COUNTY, NORTH DAKOTA.**  
Geological Survey, Bismarck, N. Dak.  
For primary bibliographic entry see Field 7C.  
W76-12786

**MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED BY THE U. S. ENVIRONMENTAL DATA SERVICE, AND BY THE U. S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.**  
Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 7C.  
W76-12794

**GEOCHEMICAL CONTROLS ON LEAD CONCENTRATIONS IN STREAM WATER AND SEDIMENTS.**  
Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 5A.  
W76-12800

**A HYPOTHESIS OF ION FILTRATION IN A POTABLE-WATER AQUIFER SYSTEM.**  
Geological Survey, Austin, Tex.  
For primary bibliographic entry see Field 4B.  
W76-12803

**DATA ON SELECTED LAKES IN WASHINGTON, PART 4.**  
Geological Survey, Tucson, Ariz.  
For primary bibliographic entry see Field 7C.  
W76-12808

**CHEMICAL DYNAMICS OF A POLLUTED WATERSHED, THE MERRIMACK RIVER IN NORTHERN NEW ENGLAND.**  
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.  
For primary bibliographic entry see Field 5B.  
W76-12833

**ATMOSPHERIC INPUT OF SOME CATIONS AND ANIONS TO FOREST ECOSYSTEMS IN NORTH CAROLINA AND TENNESSEE.**  
Forest Service (USDA), Franklin, N.C. Coweeta Hydrologic Lab.  
W. T. Swank, and G. S. Henderson.  
Water Resources Research, Vol. 12, No. 3, p 541-546, June 1976. 3 fig, 2 tab, 23 ref. AG-199, 40-193-69.

Descriptors: Chemical properties, \*Fallout, \*Precipitation (Atmospheric), \*Appalachian mountain region, \*Forest watersheds, \*North Carolina, \*Tennessee, \*Southeast U.S., \*Rain, \*Forests, \*Snow, \*Rainfall, \*Ions, \*Water quality, \*Anions, \*Cations, \*On-site data collections, \*Atmosphere, \*Seasonal.  
Identifiers: Atmospheric input, Mineral constituent, Forest ecosystems, Atmospheric contributions, Southern Appalachians, Coweeta Basin, Walker Branch, Dry fallout, Nutrient input.

The atmospheric contributions of elements in precipitation and dry fallout to forest ecosystems were measured at two sites in the southern Appalachians. At both sites, relative mean annual concentrations of cations in bulk precipitation were in the order Ca is greater than Na is greater than K is greater than Mg. At the Coweeta Hydrologic Laboratory in North Carolina, average annual inputs of Ca(++) , Na(+), K(+), Mg(++), and NH4-N in 1970-1973 were 4.88, 3.52, 1.62, 1.01, and 0.52 kg/ha/yr, respectively. At Walker Branch, Tennessee, the inputs of these elements during the same time period were 15.73, 3.89, 2.99, 2.94, and 2.37 kg/ha/yr. The inputs of NO3-N, PO4-P, and Cl(-) in 1972-1973 were 2.88, 0.19, and 8.53 kg/ha/yr at Coweeta. Inputs of NO3-N and PO4-P were 4.61 and 0.55 kg/ha at Walker Branch over the same period. One reason for differences in bulk precipitation chemistry was greater dry fallout for some cations at Walker Branch than at Coweeta. For both sites, dry fallout associated with local land use activities influenced seasonal concentrations of bulk precipitation except for Na(+), which appeared to be partly derived from marine sources. Total inputs of elements were considered to be minimum estimates for both forest ecosystems due to sampling and analytical methods. (Henley-ISWS)  
W76-12838



**CHEMISTRY OF HALOGENS IN SEAWATER,**  
Rosentiel School of Marine and Atmospheric  
Science, Miami, Fla.  
For primary bibliographic entry see Field 5A.  
W76-12684

**SOLUTE DISPERSION IN SATURATED SOIL  
COLUMNS,**  
Connecticut Agricultural Experiment Station,  
Storrs, Dept. of Soil and Water.  
For primary bibliographic entry see Field 5B.  
W76-12986

**GROUND-WATER QUALITY VARIATION IN  
HELPS COUNTY, MISSOURI,**  
Forest Service (USDA), Rolla, Mo. Clark National  
Forest.  
For primary bibliographic entry see Field 5B.  
W76-12991

**ATMOSPHERIC AEROSOLS: A LITERATURE  
SUMMARY OF THEIR PHYSICAL CHARAC-  
TERISTICS AND CHEMICAL COMPOSITION,**  
Old Dominion Univ., Norfolk, Va. School of  
Sciences.  
For primary bibliographic entry see Field 5A.  
W76-12996

**AVAILABILITY OF GROUND WATER IN THE  
MIDDLE CONNECTICUT RIVER BASIN,  
WEST-CENTRAL NEW HAMPSHIRE,**  
Geological Survey, Concord, N. H.  
For primary bibliographic entry see Field 7C.  
W76-13062

**PREIMPOUNDMENT WATER QUALITY OF  
RAYSTOWN BRANCH JUNIATA RIVER AND  
SIX TRIBUTARY STREAMS, SOUTH-CEN-  
TRAL PENNSYLVANIA,**  
Geological Survey, Harrisburg, Pa.  
For primary bibliographic entry see Field 5A.  
W76-13065

**OCCURRENCE OF ARSENIC IN THE DRY  
CREEK BASIN, SONOMA COUNTY, CALIFOR-  
NIA,**  
Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 5A.  
W76-13068

**GEOLOGY AND GROUND-WATER  
RESOURCES OF UNION COUNTY, NEW JER-  
SEY,**  
Geological Survey, Trenton, N. J.  
For primary bibliographic entry see Field 4B.  
W76-13072

**GEOHYDROLOGY OF THE OKLAHOMA PAN-  
HANDLE, BEAVER, CIMARRON, AND TEXAS  
COUNTIES,**  
Geological Survey, Oklahoma City, Okla.  
For primary bibliographic entry see Field 4B.  
W76-13081

**VERTICAL TEMPERATURE AND CHEMICAL  
GRADIENTS IN GROUNDWATER IN THE  
TUCSON BASIN, ARIZONA,**  
Arizona Univ., Tucson. Dept. of Hydrology and  
Water Resources.  
For primary bibliographic entry see Field 4B.  
W76-13129

## 2L. Estuaries

**A NON-LINEAR PROGRAMMING MODEL FOR  
EVALUATING WATER SUPPLY POLICIES IN  
THE TEXAS COASTAL ZONE,**  
Texas Univ. at Austin.

For primary bibliographic entry see Field 6D.  
W76-12680

**EFFECTS OF 1973 RIVER FLOOD WATERS ON  
BROWN SHRIMP IN LOUISIANA ESTUARIES,**  
Louisiana Wildlife and Fisheries Commission,  
New Orleans. Div. of Oysters, Water Bottoms and  
Seafoods.  
For primary bibliographic entry see Field 5C.  
W76-12693

**ON THE COEXISTENCE OF SCAVENGERS ON  
SHALLOW SANDY, BOTTOMS IN GULLMAR  
FJORD (SWEDEN), ADAPTATIONS TO SUB-  
STRATUM, TEMPERATURE, AND SALINITY,**  
Uppsala Univ. (Sweden). Inst. of Zoology.  
For primary bibliographic entry see Field 5C.  
W76-12704

**PHYSIOLOGICAL ECOLOGY OF FOUR  
POLYSIPHONIA SPECIES (RHODOPHYTA,  
CERAMIALES),**  
New Hampshire Univ., Durham. Jackson  
Estuarine Lab.; and New Hampshire Univ., Dur-  
ham. Dept. of Botany.  
For primary bibliographic entry see Field 5C.  
W76-12705

**SOME CURRENT DIRECTED MOVEMENTS  
OF MACROBRACHIUM ACANTHURUS  
(WIEGMANN 1836) (DECAPODA,  
PALAEMONIDAE) UNDER LABORATORY  
CONDITIONS,**  
Rosentiel School of Marine and Atmospheric  
Science, Miami, Fla.  
D. A. Hughes, and J. D. Richard.  
Ecology. 54(4), p 927-929, 1973.

Descriptors: \*Larvae, \*Shrimp, Brackish water,  
Estuaries, Migration, \*Salinity.  
Identifiers: Decapoda, \*Macrobrachium-acanthu-  
rus, Palaemonidae.

The larvae of some species of freshwater shrimp  
of the genus *Macrobrachium* will develop only in  
brackish water. The increased incidence of these  
shrimp within estuaries and in the lower reaches of  
rivers at certain times of the year suggests that  
regular downstream migrations are carried out to  
facilitate the transport of larvae to a brackish  
estuarine environment. Current chamber experi-  
ments conducted in the laboratory indicated that  
gravid individuals tend to swim consistently  
downstream whereas other adult females tend to  
swim consistently upstream. Other current  
chamber experiments showed that larval stages,  
held in brackish water, will drop to a position low  
in the water column when salinity is reduced  
(simulating an ebb tide) and revert to swimming  
higher in the water column when the salinity is in-  
creased (simulating a flood tide). These responses  
are interpreted as a mechanism whereby larvae are  
prevented from being carried out to sea, thus  
facilitating their eventual migration upstream to a  
freshwater environment.—Copyright Biological  
Abstracts, Inc., 1974.  
W76-12707

**DISTRIBUTION OF PELAGIC FISHES IN THE  
SHEEPSKOT RIVER-BACK RIVER ESTUARY,  
WISCASSET, MAINE,**  
Maine Univ., Orono. Dept. of Zoology.  
C. W. Recksiek, and J. D. Mc Cleave.  
Trans Am Fish Soc. 102(3), p 541-551, 1973.

Descriptors: \*Distribution, Fish, \*Maine,  
\*Estuaries.  
Identifiers: *Alosa-aestivalis*, *Alosa-mediocris*,  
*Alosa-pseudoharengus*, *Alosa-sapidissima*,  
*Brevoortia-tyrannus*, *Clupea-harengus*, *Merlu-  
cius-bilinearis*, *Morone-Americana*, *Morone-sax-  
atilis*, *Osmerus-mordax*, *Peprilus-triacas*, *Pol-  
ladius-virens*, *Pomatomus-saltatrix*, *Scomber-*

*scombrus*, *Squalus-acanthias*, Wiscasset(Maine),  
Back River, Sheepscot River, \*Pelagic fishes.

Species (15) of pelagic fishes (*Alosa sapidissima*,  
*A. mediocris*, *A. pseudoharengus*, *A. aestivalis*,  
*Clupea harengus*, *Osmerus mordax*, *Brevoortia*  
*tyrannus*, *Scomber scombrus*, *Squalus acanthias*,  
*Morone saxatilis*, *Merluccius bilinearis*, *Peprilus*  
*triacanthus*, *Pomatomus saltatrix*, *Polladius*  
*virens*, *Morone Americana*) were collected in 156  
gill net sets at 8 locations in the Sheepscot River-  
Back River estuary, Wiscasset, Maine, June 1970  
through Dec. 1971. Highest catches occurred June  
through Aug. Only the rainbow smelt is a year-  
round resident. Differences in abundance in space  
and time are apparently related to temperature.  
During the summer, alewives, blueback herring,  
and Atlantic menhaden were most abundant in the  
relatively warm Back River estuary, while Atlantic  
herring, Atlantic mackerel and spiny dogfish  
were most abundant in the more oceanic Sheep-  
scot River estuary. Prolonged near-freezing tem-  
perature apparently limit the time pelagic fishes  
spend in the estuary and limit the number of spe-  
cies which can inhabit it. It is hypothesized that  
the distribution of pelagic species which exhibited  
preferences for colder water, such as Atlantic her-  
ring, would be most affected by artificial warming  
of the surface waters of the Back River estuary if a  
new atomic powered generating plant were al-  
lowed to discharge heated effluent directly into it.  
—Copyright 1974, Biological Abstracts, Inc.  
W76-12710

**CADMIUM CONCENTRATIONS IN ROCK  
SCALLOPS IN COMPARISON WITH SOME  
OTHER SPECIES,**  
California Univ., Livermore. Lawrence Liver-  
more Lab.  
For primary bibliographic entry see Field 5C.  
W76-12715

**SPAWNING LITTORINA LITTOREA (L.)  
(GASTROPODA: PROSOBRANCHIATA),**  
University Coll. of North Wales, Menai Bridge.  
Marine Science Labs.  
For primary bibliographic entry see Field 5C.  
W76-12725

**GROWTH AND MORTALITY OF TWO  
GROUPS OF OYSTERS, (CRASSOSTREA VIR-  
GINICA Gmelin), MAINTAINED IN COOLING  
WATER AT AN ESTUARINE ELECTRIC  
POWER GENERATING STATION,**  
Moody Coll. of Marine Sciences and Maritime  
Research, Galveston, Tex. Dept. of Marine  
Sciences.  
For primary bibliographic entry see Field 5C.  
W76-12726

**REPRODUCTION AND RECRUITMENT OF  
THE BRACKISH WATER CLAM RANGIA CU-  
NEATA IN THE JAMES RIVER, VIRGINIA,**  
Nuclear Regulatory Commission, Washington,  
D.C. Div. of Technical Review.  
For primary bibliographic entry see Field 5C.  
W76-12728

**FISH INVESTIGATIONS IN LONG ISLAND  
SOUND AT A NUCLEAR POWER STATION  
SITE AT SHOREHAM, NEW YORK,**  
New York State Dept. of Environmental Conser-  
vation, Albany.  
C. S. Zawacki, and P. T. Briggs.  
New York Fish and Game Journal, Vol. 23, No. 1,  
p 35-50, 1976, 9 tab, 3 fig, 12 ref.

Descriptors: \*Fish populations, \*Nuclear power-  
plants, Sites, Atlantic menhaden, Silversides,  
Fish, Seasonal, Pesticides, Chlorine, Trace ele-  
ments, Thermal pollution, New York, Sounds.  
Identifiers: Scup, Bluefish, \*Long Island  
Sound(NY).

## Field 2—WATER CYCLE

### Group 2L—Estuaries

The purpose was to gather information on the species of fish found near the station site, their relative and seasonal abundance and their size ranges. The shore-zone waters serve seasonally as a nursery ground for several species, particularly Atlantic silverside and Atlantic menhaden. Near shore waters are important summer grounds for scup and juvenile bluefish. Specimens of two migratory (striped bass and juvenile bluefish) and one resident (windowpane) species examined showed low concentrations of DDT and its metabolites, dieldrin and trace metals. It was recommended that cooling water discharged into Long Island Sound should not exceed standards set forth by the State Department of Environmental Conservation, that shut downs for normal maintenance be scheduled at times other than winter months to prevent fishkill from sudden cold, and that the use of chlorine-bearing compounds to prevent fouling be undertaken with caution. (Chilton-ORNL)

W76-12743

**OBSERVATIONS ON FISHES KILLED BY COLD AT PORT ARANSAS, TEXAS, 11-12 JANUARY 1973.**  
Texas Univ. at Austin, Port Aransas. Marine Science Inst.  
R. H. Moore.

The Southwestern Naturalist, Vol. 20, No. 4, January 1976, p 461-466, 1 tab, 15 ref.

Descriptors: \*Environmental effects, \*Weather, Temperature, Fish, \*Fishkill, \*Thermal stress, Mortality, Estuaries, \*Texas, Water temperature.

Cold-lethal temperatures for striped mullet, red drum, sheepshead, and most other common Texas estuarine fish appear to be about 4.5 C, while activity was severely limited at temperatures below 6-7.0 C. In the case of the cold front under discussion it was concluded that mortality due to cold was limited to fish trapped in enclosed waters such as marinas. Mortalities appeared to be due to the rapid decrease in temperature rather than to prolonged exposure to cold. Slower temperature decreases might have provided more time for acclimation and the observed cold-lethal temperatures might then be lowered. (Chilton-ORNL)

W76-12744

**RECENT CYCLIC CHANGES IN CLIMATE AND IN ABUNDANCE OF MARINE LIFE,**  
Marine Biological Association of the United Kingdom, Plymouth (England).  
For primary bibliographic entry see Field 5C.

W76-12747

**THE BLUE CRAB FISHERY IN MISSISSIPPI,**  
Gulf Coast Research Lab., Ocean Springs, Miss.  
H. M. Perry.  
Gulf Research Reports, Vol. 5, No. 1, 1975, p 39-75, 9 fig, 5 tab, 51 ref.

Descriptors: \*Fisheries, \*Estuarine fisheries, \*Crabs, Growth stages, \*Overwintering sites, \*Mississippi, Parasites.

670 samples obtained by trawl, seine, and marsh net from July 1971 through June 1973 were analyzed. Salinities ranging from 5.0 to 15.0 ppt at temperatures of 20.0 to 25.0 C were associated with highest average catches. Young crabs were most often found over soft mud bottoms in dredged navigational channels and marshes fringing the bays and coastline. Peak numbers of zoeae occurred in the summer and fall. Megalopae were found throughout the year but were most abundant in September 1970, February 1971, and August 1972. A tagging program in Lake Borgne in the fall of 1971 showed that crabs tagged and released in that vicinity moved into Mississippi Sound near Cat Island to overwinter while crabs released in the St. Louis Bay, Biloxi Bay and Pascagoula River estuarine systems showed little movement

during spring and summer. Identified parasites included a new microphallid trematode. (Chilton-ORNL)

W76-12749

**BEHAVIOR OF LOBSTERS (HOMARUS AMERICANUS) IN A SEMI-NATURAL ENVIRONMENT AT AMBIENT TEMPERATURES AND UNDER THERMAL STRESS,**  
Woods Hole Oceanographic Institution, Mass.  
For primary bibliographic entry see Field 5C.

W76-12761

**SKELETONEMA MENZELII SP. NOV., A NEW DIATOM FROM THE WESTERN ATLANTIC OCEAN,**  
Woods Hole Oceanographic Institution, Mass.  
R. R. L. Guillard, E. J. Carpenter, and B. E. F. Reimann.  
Phycologia, Vol. 13, No. 2, 1974, p 131-138, 12 fig, 18 ref. NSF GB 7682 GB 20488, GZ 1131, GZ 1131, GA 379

Descriptors: Biology, \*Systematics, \*Diatoms, \*Atlantic Ocean.

Identifiers: \*Sargasso Sea, \*Skeletonema menzeli.

*Skeletonema menzeli* is related to *S. costatum* and *S. tropicum* but distinguished from them by smaller cell size, fragility of shells, shorter chain length, and irregular spacing of cells which are usually lenticular in shape. It has at most two chloroplasts per cell. The valves have 5-14 marginal strutt tubuli and a single, generally central labiate process. The valve has a pattern of fine radiate thickenings over a finely perforate silica membrane. (Chilton-ORNL)

W76-12766

**TORTUGUERO BAY ENVIRONMENTAL STUDIES,**  
Puerto Rico Nuclear Center, Mayaguez.  
For primary bibliographic entry see Field 6G.

W76-12783

**BEACH DYNAMICS AND NEARSHORE MORPHOLOGY OF THE BEAUFORT SEA COAST, ALASKA,**  
Arctic Inst. of North America, Arlington, Va.  
A. D. Short, J. M. Coleman, and L. D. Wright.  
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A-009 032, \$3.50 in paper copy, \$3.00 in microfiche. Technical Report No. 185, June 1975. 15 p, 10 fig, 14 ref. NR 388 110. N00014-69-A-0211-0005.

Descriptors: \*Barrier islands, \*Currents(Water), \*Alaska, \*Beaches, Waves(Water), Beach erosion, Geomorphology, Inlets(Waterways), Tidal waters, Tides, Estuaries, Migration.

Identifiers: \*Beaufort Sea, \*Beach dynamics, \*Nearshore morphology, Freezeup, Lagoon ice slush, Ice boulders, Frozen wash.

The beach dynamics and nearshore morphology of the Alaskan Beaufort Sea coast between Point Barrow and Demarcation Point were examined. The following conditions were found to exist: the beaches along the Beaufort Sea are subjected to wave and current action for a maximum of 3 months each year, and during this period they can be classified as wave-controlled forms. Beach volume changes during the open water period are increased by an order of magnitude during infrequent summer storms. Net longshore beach transport is toward the west and is about 10,000 cu m per year. Waves and currents have generated echelon offshore bars that occupy approximately 40% of the coast. The bars extend laterally from the shore to distances of 400 to 600 m seaward, they attain lengths of 2 to 10 km, and some are migrating westward at an average of 70 m per year. Their presence and migration have a pronounced

effect on the beach and barrier island morphology, especially the width, and on the location and migration of the dynamic barrier inlets. The barrier islands are migrating westward at 6 to 25 m per year. On tundra islands, this migration results in permanent destruction of the tundra. If wave action persists into freezeup, then lagoon ice slush, ice boulders, frozen swash, foam and spray, and snow may be interbedded and preserved within the beach sediments. Later in freezeup, sea ice ridging may occur against the beach shorefast ice and over offshore bars, permitting the beach and bars to be readily discernible during winter by air reconnaissance and from aerial photographs. (Lee-ISWS)

W76-12820

**EXPERIMENTAL STUDY OF TURBULENT STRATIFIED SHEARING FLOW,**  
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.  
V. H. Chu, and M. R. Vanvari.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY6, Proceedings Paper 12205, p 691-706, June 1976. 13 fig, 1 tab, 15 ref, 2 append. NRCC A7922.

Descriptors: \*Entrainment, Hydraulics, \*Stratified flow, \*Mixing, \*Interfaces, Equations, Velocity, Density, Laboratory tests, Turbulence, Conductivity, Anemometers, Jets, Saline water, Water pollution, Supercritical flow, \*Path of pollutants.

Identifiers: \*Turbulent shearing flow, Density jump, Richardson number.

Two-dimensional turbulent stratified shearing flow of lighter fluid flowing on top of an otherwise stationary ambient fluid of heavier density was simulated in the laboratory by letting fresh water flow over the stationary body of saline water. The behavior of the turbulent surface layer was observed to depend on upstream condition as well as downstream condition in a manner similar to the free surface flow in open channel. Velocity and concentration were measured by hot-film anemometer and conductivity probe. It was observed that a 'density jump' analogous to the open-channel hydraulic jump exists. Upstream of the jump the flow was jet-like and was characterized by turbulent mixing and entrainment similar to a neutral wall jet. This region was referred to as supercritical since it was observed to be influenced by the upstream condition only. Downstream of the jump the flow was distinguished by sharp interface with negligible entrainment. Mixing in the region of the density jump was more complicated. (Singh-ISWS)

W76-12841

**COASTAL DISPERSION OF POLLUTANTS,**  
Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.  
For primary bibliographic entry see Field 5B.

W76-12843

**ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES—MIDDLE ATLANTIC BIGHT.**  
Environmental Protection Agency, Annapolis, Md. Annapolis Science Center.  
For primary bibliographic entry see Field 5B.

W76-12875

**CONTRIBUTION ON THE KNOWLEDGE OF THE ORGANIC IN THE COASTAL WATERS OF THE GDR: V. THE VARIABILITY OF THE CHEMICAL OXYGEN CONSUMPTION AT SELECTED STATIONS OF THE WATERS IN THE SHALLOW INLETS TO THE SOUTH OF THE ZINGST PENINSULA DURING THE SYNOPSIS INVESTIGATION IN 1972, (IN GERMAN),**  
Rostock Univ. (East Germany). Dept. of Biology.  
For primary bibliographic entry see Field 5B.

W76-12916

**FATE OF METALS IN WASTEWATER DISCHARGE TO OCEAN,** CDM, Inc., Pasadena, Calif. For primary bibliographic entry see Field 5B. W76-12927

**SIGNIFICANCE OF CELLULAR NITRATE CONTENT IN NATURAL POPULATIONS OF MARINE PHYTOPLANKTON GROWING IN SHIPBOARD CULTURES,** Centre Universitaire de Luminy, Marseille (France). Laboratoire d'Océanographie. For primary bibliographic entry see Field 5C. W76-12936

**FIRST STAGES TOWARDS RANCHING SALMON ON OCEAN RANGES,** International Aquaculture Consultancy, Isle of Man (England). For primary bibliographic entry see Field 6B. W76-12949

**THE SOCIAL AND ECONOMIC IMPORTANCE OF THE CARONI SWAMP IN TRINIDAD AND TABAGO,** Michigan Univ., Ann Arbor. Dept. of Natural Resources. For primary bibliographic entry see Field 6G. W76-12952

**AN ESTIMATION OF TOTAL PRODUCTION OF PLANKTONIC COPEPODS IN NERITIC ZONE OF THE GOLFE DULION (BANYULS-SUR-MER): I. QUANTITATIVE ANNUAL VARIATION, (IN FRENCH),** Arago Lab., Banyuls-sur-Mer (France). For primary bibliographic entry see Field 5C. W76-12954

**SEDIMENT FLUSHING AFTER DREDGING IN TIDAL BAYS,** Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics. For primary bibliographic entry see Field 8C. W76-12974

**A VOLUMETRIC TEMPERATURE/SALINITY CENSUS FOR THE MIDDLE ATLANTIC BIGHT,** Woods Hole Oceanographic Institution, Mass. W. R. Wright, and C. E. Parker. Limnology and Oceanography, Vol. 21, No. 4, p 563-571, July 1976. 4 fig, 2 tab, 17 ref. NSF GA 36499.

Descriptors: \*Salinity, \*Temperature, \*Continental shelf, \*Water quality, \*Atlantic Ocean, Physical properties, Water temperature, Properties, Thermocline, Chemical properties, Sea water, Water chemistry, Saline water, Oceans, Marine geology, Continental slope, Structural geology, Estuarine environment. Identifiers: Temperature/salinity census, \*Middle Atlantic Bight, Shelf water volume, Coastal waters, \*Cape Hatteras, \*Nantucket shoals, \*Bight, Seasonal variation, Coastal runoff, Environmental influences, Volumetric diagrams, Temperature/salinity, Seasonal changes, Shelf water, Slope water.

Two seasonal volumetric temperature/salinity diagrams were prepared for the waters of the Middle Atlantic Bight from Nantucket Shoals to Cape Hatteras, to a depth of 200 m and extending as much as 130 km beyond the edge of the continental shelf. Total volume included was 23,145.6 cu km, of which about half is slope water, more saline than 35,000 mg/l. Most of it was in a distinctive subsurface maximum region near 13C, which is named the upper slope water thermostat. The less saline shelf water had two modes divided by a minimum near 33,600 mg/l. The fresher mode, as-

sociated with shallow depths, was identified as coastal water; that from 33,600-35,000 mg/l was called shelf edge water, and much of it is found seaward of the shelf break. There was very little seasonal change in the total volume of shelf water, but its geographical distribution varied, showing the effects of spring runoff and suggesting a summer influx of slope water in the northern portion of the bight. Comparison with a similar census for the Gulf of Maine and shelf waters to the east showed some overlap, but little evidence of substantial exchange. (Henley-ISWS) W76-12990

**SURFACE WATER TEMPERATURES AT SHORE STATIONS, UNITED STATES WEST COAST, 1973,** Scripps Institution of Oceanography, La Jolla, Calif. For primary bibliographic entry see Field 7C. W75-12995

**CHANGES OCCURRING IN THE OCEANIC PORTION OF THE COLVILLE RIVER DELTA, ALASKA, DURING SPRING FLOODING,** Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology; and Louisiana State Univ., Baton Rouge. Coastal Studies Inst. For primary bibliographic entry see Field 2C. W76-12997

**ANNOTATED BIBLIOGRAPHY ON THE GEOLOGIC, HYDRAULIC, AND ENGINEERING ASPECTS OF TIDAL INLETS,** Army Engineer Waterways Experiment Station, Vicksburg, Miss. J. H. Barwis. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A020 355, \$3.50 in paper copy, \$3.00 in microfiche. GITI Report 4, January 1976. 340 p.

Descriptors: \*Bibliographies, \*Inlets (Waterways), \*Hydraulics, \*Coasts, Abstracts, Publications, Channels, \*Estuaries, Tides, Surface waters, Littoral, \*Coastal engineering, Geology, Stratigraphy, Tidal effects, Engineering structures.

Abstracts and annotations were given for about 1000 published and unpublished reports, dated 1973 and earlier, on the geologic and engineering aspects of tidal inlets. Insofar as they relate to inlets, references were given on tidal hydraulics, engineering structures, littoral processes, stratigraphy and geologic history, coastal aerial photography, and Corps of Engineers reports of investigation of individual inlets. The bibliography was assembled and indexed to provide a basis for dialog between workers more familiar with the hydraulics and engineering literature, and those more familiar with the sedimentologic and geologic literature. The citations embraced a diverse range of subjects that are pertinent insofar as they aid comprehension of inlet-related phenomena. (Humphreys-ISWS) W76-12999

**NORTH CAROLINA MARINE ALGAE. VI. SOME CERAMIALES (RHODOPHYTA), INCLUDING A NEW SPECIES OF DIPTEROSIPHONIA,** Duke Univ., Durham, N.C. Dept. of Botany. For primary bibliographic entry see Field 5C. W76-13025

**WATER QUALITY MODEL OF A SALT-WEDGE ESTUARY,** Geological Survey, Tacoma, Wash. For primary bibliographic entry see Field 5B. W76-13063

**EPIFAUNA AT JACKSON POINT IN PORT VALDEZ, ALASKA, DECEMBER 1970 THROUGH SEPTEMBER 1972,** Geological Survey, Anchorage, Alaska. For primary bibliographic entry see Field 5A. W76-13070

**TWO-DIMENSIONAL STEADY-STATE DISPERSION IN A SATURATED POROUS MEDIUM,** Geological Survey, Menlo Park, Calif. For primary bibliographic entry see Field 2F. W76-13071

**A PRELIMINARY ASSESSMENT OF THE ENVIRONMENTAL VULNERABILITY OF MACHIAS BAY, MAINE TO OIL SUPERTANKERS,** Massachusetts Inst. of Tech., Cambridge. For primary bibliographic entry see Field 6G. W76-13087

**THE POTENTIAL EFFECTS OF INCREASING OIL TANKER SIZE ON NARRAGANSETT BAY. AN ADVISORY REPORT TO THE COASTAL RESOURCES MANAGEMENT COUNCIL,** Rhode Island Statewide Planning Program, Providence. For primary bibliographic entry see Field 6G. W76-13088

**POSSIBLE EFFECTS OF CONSTRUCTION AND OPERATION OF A SUPERTANKER TERMINAL ON THE MARINE ENVIRONMENT IN THE NEW YORK BIGHT,** State Univ. of New York at Stony Brook. Marine Sciences Research Center. For primary bibliographic entry see Field 6G. W76-13089

**ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA, VOLUME I.** Resource Planning Associates, Inc., Cambridge, Mass. For primary bibliographic entry see Field 5G. W76-13090

**ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA. VOLUME II. METHODOLOGY APPENDICES.** Resource Planning Associates, Cambridge, Mass. For primary bibliographic entry see Field 5G. W76-13091

**THE DEVELOPMENT CRITERIA OF THE PRELIMINARY COASTAL PLAN,** University of Southern California, Los Angeles. School of Public Administration. R. Lutz, T. Raub, and B. J. Washom. Available from the National Technical Information Service, Springfield, VA 22161 as COM-75-11476, \$4.00 in paper copy, \$3.00 in microfiche. Sea Grant Report No. USC-SG-ASI-75, August 1975. 33 p, 1 fig.

Descriptors: \*Planning, \*Resources development, \*Environmental effects, \*Management, \*Water resources development, \*Water management (Applied), \*Land use, \*Conservation, Comprehensive planning, Estimated benefits, Regional development, Coastal plains, Coastal structures, Natural resources, Water utilization, \*California. Identifiers: \*Coastal zone planning (Calif).

A chart and attached text is designed for public users and developers of the California coastal zone as an easy reference and index to those policies of the Preliminary Coastal Plan which set forth criteria for development in the coastal zone. It is not intended to be used in lieu of the Plan, but rather as a guide to it. The chart is used to determine the type of development or activity involved



## Field 2—WATER CYCLE

### Group 2L—Estuaries

in the Preliminary Coastal Plan, to see what coastal resource values might be affected and to ascertain the policy intent and criteria. One hundred and eighty-two statement of policy intent are delineated. (Sinha-OEIS)  
W76-13092

**A WATER-QUALITY SIMULATION MODEL FOR WELL MIXED ESTUARIES AND COASTAL SEAS: VOLUME VIII, AN ENGINEERING ASSESSMENT.**  
Rand Corp., Santa Monica, Calif.  
J. J. Leendertse, and S.-K. Liu.  
The New York City-Rand Institute Report No. R-1791-NYC, December 1975. 219 p, 8 ref, 10 append.

Descriptors: \*Estuaries, \*Coasts, \*Water quality, \*Hurricanes, \*Engineering structures, \*Barriers, \*Coliforms, \*Environmental effects, \*Bacteria, \*Chlorides, Dissolved oxygen, Tides, Winds.  
Identifiers: Coastal zone, Simulation models, Wind direction.

An assessment of the impact on water quality of a hurricane barrier across Rockaway Inlet, Jamaica Bay, New York is presented. Two simulation models for a barrier were considered. From simulations it was concluded that: the proposed hurricane barrier plans cause slight phase retardation in the tidal propagation in the Jamaica Bay system; the plans slightly decrease the counter-clockwise net circulation of the eastern portion of the bay by approximately 3% for both plans; the prevailing wind direction substantially influences the direction of the net circulation in the northwestern portion of the bay; the barrier has an insignificant influence on wind-induced circulation; the proposed barrier plans create no significant change in the transient (short-term) dispersion and transport of pollutants such as coliform bacteria discharged in the bay; with the Water Pollution Control Facilities around Jamaica Bay operating in the upgraded mode with 90% BOD removal, the amount of reduction creates negligible stress on the oxygen distribution in this area; and the construction of the barrier will induce only insignificant changes in the chloride concentrations and distributions as well as in concentration and distributions of conservative substances discharged in the bay from the present condition. (See also W76-08317; W75-07042; W73-07935; W72-06980; and W71-04038) (Sinha-OEIS)  
W76-13093

**THE COASTAL PLAINS REGIONAL COMMISSION--U.S. GEOLOGICAL SURVEY. AEROMAGNETIC-AERORADIOACTIVITY SURVEY.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7B.  
W76-13099

**THE VIRGINIA INSTITUTE OF MARINE SCIENCE, VIRGINIA'S MARINE SCIENCE, ENGINEERING, EDUCATION, AND ADVISORY SERVICES PROGRAM.**  
Virginia Inst. of Marine Science, Gloucester Point.  
For primary bibliographic entry see Field 6E.  
W76-13100

**SEAFOOD PROCESSING IN RELATION TO COASTAL INDUSTRIAL PARK CONCEPTS.**  
North Carolina State Univ., Raleigh. Dept. of Food Science.  
For primary bibliographic entry see Field 6B.  
W76-13101

**WASTE DISPOSAL IN SEAFOOD PROCESSING: PUBLIC OR PRIVATE.**  
Georgia Univ., Athens. Inst. of Natural Resources.  
For primary bibliographic entry see Field 5D.  
W76-13102

**SHRIMP SUPPLIES IN THE SOUTHEAST AND THEIR EFFECT ON PROCESSING FIRM SIZE.**  
Florida Univ., Gainesville. Dept. of Food and Resource Economics.  
For primary bibliographic entry see Field 6C.  
W76-13103

**LEGAL ASPECTS OF PUBLIC ACCESS TO BEACHES.**  
Hartzog, Lader, and Richards, Hilton Head Island, S.C.  
For primary bibliographic entry see Field 6E.  
W76-13104

**BACK BAY NATIONAL WILDLIFE REFUGE. SOME PARALLELS IN IMPLEMENTING THE COASTAL ZONE MANAGEMENT ACT.**  
Back Bay National Wildlife Refuge, Virginia Beach, Va.  
For primary bibliographic entry see Field 6E.  
W76-13105

**FREEDOM OF THE BEACHES: IS IT POSSIBLE.**  
Bureau of Outdoor Recreation, Atlanta, Ga. Southeast Regional Office.  
For primary bibliographic entry see Field 6E.  
W76-13106

**THE ROLE OF INTERSTATE COMPACTS IN FISHERIES MANAGEMENT.**  
Atlantic States Marine Fisheries Commission, Washington, D.C.  
For primary bibliographic entry see Field 6E.  
W76-13107

**STATE-FEDERAL MANAGEMENT PLANNING FOR MARINE FISHERIES: TODAY AND TOMORROW.**  
National Marine Fisheries Service, Washington, D.C. Fisheries Management Div.  
For primary bibliographic entry see Field 6E.  
W76-13108

**DIATOM COMMUNITIES FROM A DELAWARE SALT MARSH.**  
Delaware Univ., Newark. Dept. of Biological Sciences.  
For primary bibliographic entry see Field 5C.  
W76-13118

**QUALITATIVE AND QUANTITATIVE SALMONELLA INVESTIGATIONS AND THEIR HYGIENIC VALUATION IN CONNECTION WITH E. COLI TITRE, DEMONSTRATED WITH EXAMPLES FROM THE COASTAL WATERS OF KIEL BIGHT (WESTERN BALTIC SEA), (IN GERMAN).**  
Kiel Univ. (West Germany). Hygiene Institut.  
For primary bibliographic entry see Field 5A.  
W76-13140

**DESIGNING REGIONALIZED WASTE WATER TREATMENT SYSTEMS.**  
Ohio State Univ., Columbus. Department of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-13166

**AN ERTS-1 STUDY OF COASTAL FEATURES ON THE NORTH CAROLINA COAST.**  
Coastal Engineering Research Center, Fort Belvoir, Va.  
For primary bibliographic entry see Field 7B.  
W76-13174

**TECHNIQUES IN EVALUATING SUITABILITY OF BORROW MATERIAL FOR BEACH NOURISHMENT.**  
Coastal Engineering Research Center, Fort Belvoir, Va.  
For primary bibliographic entry see Field 8B.  
W76-13175

**STOCHASTIC SEA STATE FOR SRB STUDIES.**  
Northrop Services, Inc., Huntsville, Ala. M. Perlmutter, and M. E. Graves.  
Report No. NASA CR-2649, February 1976. 46 p, 7 fig, 6 tab, 12 ref. NASA NAS8-21810.

Descriptors: \*Model studies, \*Ocean waves, \*Winds, Waves(Water), Stochastic processes, Monte Carlo method, Mathematical models, Ocean currents, Oceanography, Equations, Simulation analysis, Graphical analysis.  
Identifiers: \*Ocean wave models, Wave heights, Solid rocket booster, Wave slopes.

Ocean surface characteristics at two locations were studied for a Space Shuttle solid rocket booster ocean impact and recovery analysis. Probability distributions of wave heights, wave slopes, wave velocities, ocean currents, and 1-kilometer altitude winds were formulated. Procedures for generating ocean wave simulations were also described. (Sims-ISWS)  
W76-13177

**THE FEASIBILITY OF OIL-POLLUTION DETECTION AND MONITORING FROM SPACE: EXAMPLES USING ERTS-1 AND SKYLAB DATA.**  
Environmental Research Inst., of Michigan, Ann Arbor. Infrared and Optics Div.  
For primary bibliographic entry see Field 5A.  
W76-13181

**BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS.**  
Environmental Research Inst. of Michigan, Ann Arbor. Resources and Technology Div.  
R. A. Shuchman, C. T. Wezernak, D. R. Lyzenga, and F. J. Thomson.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A019 959, \$4.00 in paper copy, \$3.00 in microfiche. Quarterly Report 108900-4-L, October 1975. 33 p, 8 fig, 20 ref, append. ONR N00014-74-C-0273.

Descriptors: \*Beaches, \*Coasts, \*Remote sensing, Microwaves, Radar, Sands, Moisture content, Particle size, Reflectance, Sampling, Shallow water, Shores, Model studies, Mathematical studies, Air-water interfaces, Laboratory tests, On-site investigations.

A program in coastal dynamics has been developed to determine which beach and nearshore features are of interest to the researchers active in the coastal dynamic programs and to determine the extent to which these features can be mapped by remote sensing systems. Progress to date in using processing techniques to extract coastal bottom information from passive multispectral scanner (MSS) data was presented in the July 15 through October 15, 1975 quarterly report. A summary was presented on development of a reflectance model used to obtain information on coastal bottom compositions. Progress in the beach environment task was reported. During the reporting period the lab analysis on the thirty new beach samples was completed and the results loaded into a computer file for statistical analysis. The radar study is nearly completed. This task is a small effort of the total program and deals with the problem of rocky beach recognition. Various existing theories for equating radar backscatter to terrain roughness were explored. The strengths and shortcomings of the various theories were studied. (Sims-ISWS)  
W76-13182

## Saline Water Conversion—Group 3A

## BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS.

Environmental Research Inst. of Michigan, Ann Arbor. Resources and Technology Div.  
R. A. Shuchman, C. T. Wezernak, D. R. Lyzenga, D. Leu, and F. J. Thomson.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A017 273, \$4.50 in paper copy, \$3.00 in microfiche. Quarterly Report 108900-3-L, July 1975. 53 p, 15 fig. 39 ref. ONR N00014-74-C-0273.

Descriptors: \*Beaches, \*Coasts, \*Remote sensing, Microwaves, Radar, Sands, Moisture content, Particle size, Reflectance, Sampling, Shallow water, Shores, Model studies, Mathematical studies, Air-water interfaces, Laboratory tests, On-site investigations.

A program in coastal dynamics has been developed to determine which beach and nearshore features are of interest to the researchers active in the coastal dynamic program and to determine the extent to which these features can be mapped by remote sensing systems. Progress to date in using processing techniques to extract bottom information from passive multispectral scanner (MSS) data was presented in the April 15 through July 15, 1975 quarterly report. A brief theoretical consideration was included reviewing the rationale for use of a minimum 2-channel 'modified' ratio method to obtain information about bottom compositions. While progress in the beach environment task during this reporting period consisted primarily of lab work (i.e., preparing samples for reflectance measurements and obtaining geologic information about samples) theoretical evidence was presented that justifies the channels chosen to diagnose grain size and moisture content of the first year's twenty samples. The radar study task is a small effort of the total program. It deals with the problem of rocky beach recognition. This task demonstrates the potential usefulness of multichannel imaging radar to yield information where the beach environment task (i.e., passive MSS) has its upward bounds, the 2 mm grain size. A short description using data from a two-wavelength radar was given demonstrating radar's utility in determining rock size. (Sims-ISWS)  
W76-13183

## APPLICATIONS OF REMOTE SENSING TO ESTUARINE PROBLEMS.

Virginia Inst. of Marine Science, Gloucester Point.  
J. C. Munday, Jr., R. J. Byrne, C. S. Welch, H. H. Gordon, and J. D. Boon, III.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-15526, \$7.50 in paper copy, \$3.00 in microfiche. Annual Report No. 3, December 1975. 168 p, 38 fig, 13 tab, 15 ref, 2 append. NASA-NGL 47-022-005.

Descriptors: \*Remote sensing, \*Aerial photography, \*Buoys, \*Dye releases, \*Virginia, \*Chesapeake Bay, Circulation, Water circulation, Rivers, Estuaries, Shores, Pollution, Sewage effluents, Dredging, Oil pollution, Water quality, Dye dispersion, Tides, Tidal waters, Coasts.  
Identifiers: Dye buoys.

A variety of siting problems for the estuaries of the lower Chesapeake Bay have been solved with cost beneficial remote sensing techniques. Principal techniques used were repetitive 1:30,000 color photography of dye-emitting buoys to map circulation patterns, and investigation of water color boundaries via color and color infrared imagery to scales of 1:120,000. Problems solved included sewage outfall siting, shoreline preservation and enhancement, oil pollution risk assessment, and protection of shellfish beds from dredge operations. (Sims-ISWS)  
W76-13184

## CONCENTRATIONS OF MERCURY, CADMIUM, LEAD AND COPPER IN THE SURROUNDING SEAWATER AND IN SEAWEEDS, UNDARIA PINNATIFIDA AND SARGASSUM FULVELLUM, FROM SUYEONG BAY IN FUSAN, (IN KOREAN),

Pusan Fisheries Coll. (Republic of Korea).  
For primary bibliographic entry see Field 5A.  
W76-13190

## CONTENT OF SOME TRACE ELEMENTS IN MACROPHYTES OF THE VOLGA DELTA, (IN RUSSIAN),

Kaspiiskii Nauchno-Issledovatel'skii Institut Rybnogo Khozyaistva, Astrakhan (USSR).  
For primary bibliographic entry see Field 5A.  
W76-13194

## 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3A. Saline Water Conversion

## THE IMPACT OF INCREASED FUEL COSTS AND INFLATION ON THE COST OF DESALTING SEA WATER AND BRACKISH WATERS,

Oak Ridge National Lab., Tenn.  
S. A. Reed.  
Report ORNL-TM-5070, December 1975, 25 p, 6 fig, 1 tab, append. W-7405-Eng-26.

Descriptors: \*Desalination, \*Costs, Desalination plants, Desalination processes, Cost analysis, Brackish water, Waste water treatment, Capital costs.

The rapid increase in the price of fuels and the escalation in all capital cost areas along with high interest rates during the last 3 to 5 years have had a marked impact on the cost of desalting saline waters. For 100 Mgd plant sizes, distillation plant capital costs have risen from \$1 per daily gallon to \$3 per daily gallon and for plant sizes of 5 Mgd or less from \$1.40 per daily gallon to about \$5 per daily gallon. Similarly, the costs for desalting brackish waters via electrodialysis, reverse osmosis, or ion exchange have increased significantly. The report presents the results of a parametric study to estimate the current costs of desalting sea water and brackish waters as a function of plant size and feed water chemistry. (Chilton-ORNL)  
W76-12778

## HYGIENIC EVALUATION OF THE QUALITY OF WATER DESALINATED IN INDUSTRIAL ELECTRODIALYSIS INSTALLATIONS UNDER CONDITIONS OF COUNTRY SETTLEMENTS, (IN RUSSIAN),

Meditsinskii Institut Saratov (USSR).  
For primary bibliographic entry see Field 5F.  
W76-12910

## THE ROLE OF DESALTING AND BRACKISH WATER RESOURCES IN THE ARID REGIONS OF THE AMERICAS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.  
R. F. Probst, and J. M. Alvarez.  
Interiencia, Vol 1, No 1, p 17-23, May-June 1976. 6 fig, 20 ref.

Descriptors: \*Desalination, \*Desalination processes, \*Brackish water, \*Water resources development, \*Water management (Applied), Arid lands, \*Mexico, Reverse osmosis, Ion exchange, Electrodialysis, Economic feasibility, Planning, \*South America, \*United States, Waste water treatment.

Economic and technological limitations of desalination for arid land development are mostly

surmounted by use of brackish waters (i.e., those having a dissolved salt or solids content less than 15% of salt water). Various desalting techniques appropriate for brackish water purification are described, including the newer membrane and adsorption methods (reverse osmosis, electrodialysis and ion exchange). Such purification can be done at a moderate cost, is useful for a wide range of capacities and is simple enough to be viable under various arid conditions. Location and quality of brackish surface and ground waters are described using maps of the United States, Mexico and South America. Suggested development of these resources is outlined for Latin America; priorities include mapping of brackish water resources in the arid regions, establishment of regional desalting test stations and advanced research and development programs. A comprehensive and systematic approach is emphasized. (Jahns-Arizona)  
W76-13133

## SEA WATER DESALINATION APPARATUS,

Snam Progetti S.p.A., Milan (Italy). (Assignee).  
G. Pagani.  
U. S. Patent No. 3,961,658, 4 p, 5 fig, 6 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 624, June 8, 1976.

Descriptors: \*Patents, \*Desalination, \*Water purification, \*Water quality control, Sea water, Distillation, Long-tube vertical distillation, Desalination apparatus, Evaporators, Condensers.  
Identifiers: Multiple-effect distillation.

An apparatus for the desalination of sea water is comprised of a column of a number of superposed cylindrical sections. Each section includes two film evaporators, two basins, interconnected between the cylindrical sections, a restriction for passing brine from basin to basin, siphon tubes for withdrawing the condensed water from each section and accessory preheating means and inlet and outlet tubes. This invention is a multiple-effect distillation process based on the principle of evaporation and succeeding condensation. The vapor produced in one stage is permitted to condense in the following stage for producing vapor at a lower thermal level and so on for all the other stages. (Sinha-OEIS)  
W76-13136

## NOVEL POLYMER MEMBRANES FOR REVERSE OSMOSIS,

Babcock and Wilcox Ltd., London (England). (Assignee).  
For primary bibliographic entry see Field 5F.  
W76-13153

## APPARATUS FOR THE PREVENTION OF SCALING IN DESALINATION APPARATUS,

Commissariat a l'Energie Atomique, Paris (France); and Compagnie des Salins du Midi et des Salines de l'Est, Paris (France). (Assignee).  
A. Cailaud, P. Charuit, C. Daffau, and J. Ravoire.  
U. S. Patent No. 3,963,619, 5 p, 4 fig, 9 ref; Official Gazette of the United States Patent Office, Vol 947, No 3, p 1264, June 15, 1976.

Descriptors: \*Patents, \*Desalination, \*Water purification, \*Water treatment, \*Desalination apparatus, \*Scaling, Sea water, Potable water.  
Identifiers: Seed crystals.

Apparatus for producing fresh water from sea water or briny water which operates on the evaporation-distillation principle has a limited capacity owing to upper temperature and operating limits imposed by scaling. This invention relates to a device of simple design for decanting crude sea water solutions containing the scaling salts and which lends itself to use in combination with conventional apparatus used in desalination processes. An apparatus for separating solids from a liquid suspension using an evaporator/decanter has an outer and inner vessel and an inverted fun-

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3A—Saline Water Conversion

nel member housed within the inner vessel, the leg of the funnel extending through the top of the inner vessel. A gutter member, mounted around the inner circumference of the inner vessel collects the clarified water. In a process for removing scaling agents from sea water, seed crystals are added to the sea water which is then heated to a temperature above the solubility limits of the scaling agents and above the operating temperatures of a desalination unit to cause the scaling agent to crystallize on the seed crystals. The seed crystal solution is then fed into the outer vessel of the apparatus to effect removal of the crystals and produce a clarified sea water feed for the desalination unit. (Sinha-OEIS)  
W76-13154

### 3B. Water Yield Improvement

**A SUMMARY OF THE GROUND-WATER HYDROLOGY OF THE AREA BETWEEN THE LAS VEGAS VALLEY AND THE AMARGOSA DESERT, NEVADA, WITH SPECIAL REFERENCE TO THE EFFECTS OF POSSIBLE NEW WITHDRAWALS OF GROUND WATER,** Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 4B.  
W76-12807

**FLOODWATER RETARDING STRUCTURE YIELD IMPACT,** Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.  
For primary bibliographic entry see Field 4A.  
W76-12978

**A SECOND LOCALITY FOR NATIVE CALIFORNIA FAN PALMS (WASHINGTONIA FILIFERS) IN ARIZONA,** Geological Survey, Tucson, Ariz.  
For primary bibliographic entry see Field 2I.  
W76-13069

**STUDIES ON NUMERICAL MODelling AND MODIFICATION OF CYCLONE SCALE PRECIPITATION,** Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.  
F. Baer, D. B. Rao, and D. Boudra.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A022 470, \$4.50 in paper copy, \$3.00 in microfiche. Final Report, January 1976. 62 p, 11 fig, 4 tab, 26 ref, 2 append. ARO DAHC04-73-C-0001.

**Descriptors:** \*Model studies, \*Precipitation(Atmospheric), \*Forecasting, \*Weather modification, Mathematical models, Rainfall, Atmosphere, Atmospheric physics, Cloud physics, Cloud seeding, Finite element analysis, Condensation, Meteorology.

A fine-mesh limited area model was developed both to predict precipitation over a limited geographic region, and to be utilized in experiments with precipitation modification. The model utilized the primitive equations, incorporated fifteen levels in the vertical, and had a basic grid length of 80 km. It showed many of the features of current models of its type, but lacked resolution in the boundary layer. Lateral boundary conditions were specified when needed from a data set which also provided initial conditions and comparisons for the forecasts. Finite-difference integrations were performed but spectral techniques were studied. Forecasts with the model showed some fidelity to observations but some short-comings also. Setting one integration as a control, a number of experiments were performed with model modifications and compared to the control. In all cases, modification did not substantially alter the flow field over a 24 hour period. Precipitation forecasts were altered however. By reducing condensation re-

lated to cloud top temperature, implying lack of freezing nuclei, regions of marginal precipitation showed almost no precipitation. With enhanced condensation based on cloud seeding, these regions showed significant increase in precipitation. The addition of carbon black to the model for heating did not show substantial changes in precipitation. Modified initial conditions based on poor (coarse grid) resolution has a significant effect on precipitation predictions. (Sims-ISWS)  
W76-13185

### 3C. Use Of Water Of Impaired Quality

**THE VEGETATION OF DUNE SLACKS AT NEWBOROUGH WARREN: III. PLANTAGO CORONOPUS,** Nigeria Univ., Nsukka. Dept. of Botany.  
S. S. C. Onyekwelu.  
J Ecol. 60(3), p 907-916, 1972.

**Descriptors:** \*Vegetation, \*Phosphorus, \*Nitrogen, \*Germination, Dunes, Topography, Ecology, Sea water, Salts.  
**Identifiers:** \*Plantago-Coronopus, \*Wales, \*Dune slacks.

Some aspects of the autecology of *P. coronopus* were studied (at Anglesey, Wales) by pattern analysis technique and experiment. The scale of pattern exhibited was related to microtopography. Experimental studies show a better performance at lower water tables. The poor performance in the dune slacks is attributed to low N and P status. Germination is retarded in the dark and with increase in soil depth. There is no effect on germination when the seeds are chilled, and though there is no germination in 50% sea water, the high salt content shows no considerable injury to the seeds. There is no fall of viability with storage.—Copyright 1973, Biological Abstracts, Inc.  
W76-12911

**PLANNING FOR WATER RECREATION IN ISRAEL,** Technion-Israel Inst., of Tech., Haifa. Center for Urban and Regional Studies.  
For primary bibliographic entry see Field 6B.  
W76-12959

**IRRIGATION REUSE SYSTEMS—A PROPOSED NEW ASAE ENGINEERING PRACTICE,** Colorado State Univ., Fort Collins. Dept. of Agricultural.  
W. E. Hart.

Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 24 p, 4 fig, 1 tab, 30 ref. ASAE Paper 75-2542.

**Descriptors:** \*Irrigation systems, \*Irrigation practices, \*Irrigation design, \*Irrigation engineering, Irrigation water, Irrigation, Agriculture, Furrow irrigation, Surface irrigation, Publications, Water reuse.  
**Identifiers:** \*Reuse systems(Irrigation).

A subcommittee of the Surface Irrigation Technical Committee (SW-242) has prepared a draft document which will be submitted for consideration as an ASAE Engineering Practice. This document, has six sections—purpose and scope, definitions, system analysis, determination of runoff, system design, and costs. (Skogerboe-Colorado-State)  
W76-13016

**WATER ECONOMY AND DRINKING REGIME OF THE BEDOUIN GOAT,** Tel-Aviv Univ. (Israel). Dept. of Zoology.  
A. Shkolnik, A. Borut, I. Choshniak, and A. Maltz.

In: Symposium Israel-France, Ecological Research on Development of Arid Zones (Mediterranean Deserts) with Winter Precipitation. Special Publication 39, Department of Scientific Publications, Volcani Center, Bet Dagan, Israel, p. 79-90, 1975. 5 fig, 2 tab, 11 ref.

**Descriptors:** \*Goats, \*Xerophilic animals, \*Water requirements, Animal metabolism, Adaptation, Moisture stress, Carrying capacity, Animal physiology, Water balance.  
**Identifiers:** \*Bedouin goats.

Black Bedouin goats are the only domestic ruminants except camels which thrive in desert areas; water is normally given to them every 2 to 4 days, even in summer. They have withstood long periods of deprivation under experimental conditions of 30 degrees C and 30% relative humidity while maintaining their appetite. Their resistance to dehydration may be due to a high body water content enhanced by a low rate of water exchange with the environment. After deprivation, these goats can replenish their body water content by drinking volumes of water exceeding 40% of body weight. Field studies on a desert herd confirmed the general adaptive pattern noted in the laboratory. Compared with sheep and another local goat breed, the Bedouin goat had superior efficiency in exploiting the meager desert pasture where water sources were widely spaced. Lactating goats had an even higher body water content than nonlactating ones. High milk production is maintained during periods of water shortage. The Bedouin goat has a low metabolic rate and consumes about one-third the caloric intake of the mountain goat. (Jahns-Arizona)  
W76-13125

**ASPECTS OF SOIL SALINITY AND SODICITY IN RELATION TO IRRIGATION AND RECLAMATION,** Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Dept. of Soil and Water.  
J. Shalhevet.

In: Symposium Israel-France: Ecological Research on Development of Arid Zones (Mediterranean Deserts) with Winter Precipitation. Special Publication 39, Department of Scientific Publications, Volcani Center, Bet Dagan, Israel, p. 117-140, 1975. 14 fig, 54 ref.

**Descriptors:** \*Saline soils, \*Land reclamation, \*Encroachment, \*Irrigation effects, \*Alkaline soils, Sodium, Soil physical properties, Soil chemistry, Irrigation water, Leaching, Soil dynamics, Subsurface drainage, Carbonates.  
**Identifiers:** Equivalent dilution principle.

The rate of soil salt accumulation depends mainly on the amount of salt entering with irrigation water and the quantity of water used in excess of that needed for plants. This paper discusses that relationship as modified by soil chemical and physical properties and crop growth. Also described are irrigation practices influencing salt accumulation patterns in time and space in relation to crop response. Leaching usually eliminates soil salts accumulated through geologic processes or human intervention. Soil salt movement is controlled largely by convective water flow and diffusion. Simple models for the prediction of salt leaching are outlined, along with the influences of water flow rate, moisture content and the necessity of artificial subsurface drainage. Sodidity may develop after leaching, or the soil may initially contain a high relative sodium concentration. A high sodium concentration causes structural breakdown and reduced permeability, depending on total electrolyte concentration and soil characteristics. High carbonate concentration may aggravate the condition. Sodic soil reclamation using amendments is discussed, along with the use of the equivalent dilution principle. (Jahns-Arizona)  
W76-13126



## Conservation In Industry—Group 3E

**COMBINED IRRIGATION AND FERTILIZATION OF TOMATOES GROWN ON SAND DUNES.**

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Chemistry and Plant Nutrition.

B. Sagiv, J. Ben Asher, B. Bar Yosef, U. Kafkafi, and D. Goldberg.

In: Symposium Israel-France: Ecological Research on Development of Arid Zones (Mediterranean Deserts) with Winter Precipitation. Special Publication 39, Department of Scientific Publications, Volcani Center, Bet Dagan, Israel, p. 141-146, 1975. 4 tab, 5 ref.

Descriptors: \*Irrigation efficiency, \*Nutrient requirements, \*Fertilization, \*Water requirements, \*Tomatoes, \*Dunes, Irrigation effects, Soil-water-plant relationships, Crop production, Sprinkler irrigation, Phosphorus, Sierozems, Soil profiles, Root development.

Identifiers: \*Trickle irrigation.

Knowledge of plant nutrition and irrigation was applied to an experiment in which tomatoes were grown on sand dunes using minimal water and nutrients. The best yield was obtained using a liquid fertilizer with N, P and K supplied daily with trickle irrigation. This treatment had the greatest dry matter production and highest N, P and K uptake. Water and nutrient concentrations in the soil profile, root penetration and nutrient uptake are discussed for this and two other treatments. Broadcast and disced superphosphate was recovered from the 0-20 cm layer with sprinkler irrigation 46 days after seeding, while its concentration in the soil was greatly reduced at the end of the growing period. When phosphorus was not supplied with trickle irrigation, the soil P was washed away and concentrated at 30 cm from the plant after 46 days. Only a continuous supply of P with trickling water caused P concentration near the plant to be higher than that at a distance and kept it higher near the stem to the end of the growing period. Trickle irrigation caused a concentration of roots near the stem. Determination of various factors relating to effective fertilization and irrigation is described. (Jahns-Arizona)

W76-13127

**3D. Conservation In Domestic and Municipal Use****HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS METROPOLITAN AREA, 1974.**

Geological Survey, Austin, Tex.  
For primary bibliographic entry see Field 7C.  
W76-12804

**A SUMMARY OF THE GROUND-WATER HYDROLOGY OF THE AREA BETWEEN THE LAS VEGAS VALLEY AND THE AMARGOSA DESERT, NEVADA, WITH SPECIAL REFERENCE TO THE EFFECTS OF POSSIBLE NEW WITHDRAWALS OF GROUND WATER.**

Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 4B.  
W76-12807

**EVALUATION OF THE REPORT ON INTERCEPTOR SEWERS AND SUBURBAN SPRAWL.**

Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation.  
For primary bibliographic entry see Field 5D.  
W76-12915

**WICHITA FALLS IMIS PROJECT. WATER UTILITY PROCESSING SYSTEM APPLICATION EVALUATION REPORT.**

Kansas Univ., Lawrence. Inst. for Social and Environmental Studies.  
J.T. Edwards, and J. Zelinka.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 827, \$5.50 in paper copy, \$3.00 in microfiche. Report USAC-WFT 2-5016. Prepared for the Department of Housing and Urban Development, April 1975. 113 p, 1 fig, 66 tab, 5 append. H-1217.

Descriptors: \*Evaluation, \*Information exchange, \*Management, \*Accounting, Finance, Cities, Cost-benefit analysis, Cost analysis, \*Texas. Identifiers: \*Integrated Municipal Information System (IMIS), \*Urban Systems Advisory Committee (USAC), \*Water Utility Processing System (WUPS), \*Wichita Falls (TX), Municipal information systems.

The specific Integrated Municipal Information System (IMIS) project in Wichita Falls was the Water Utility Processing System (WUPS) operating in the Utility Collections Department concerned with meter reading, service change order processing, cash collection and customer servicing, accounts reporting, accounts auditing and ledger 'A' accounts processing. Impacts of implementation were evaluated in regard to manpower cost, efficiency and function; users of the system; and other municipal activities. Installation of WUPS caused: (1) initial disruption of service as personnel learned the automated system; (2) slight savings in labor and manpower costs; (3) more accessible and reliable financial and non-financial information; (4) increased integration of official city and private business operations due to this previously unwieldy data base; (5) increased analytical capacity encouraging more accurate and efficient municipal activities. Long run efficiencies occurred in meter reading which was simplified and streamlined by automatic routing and continuous development of contiguous books; data entry and retrieval; information processing where billing and information storage errors are reduced; and data analysis is facilitated by extensive and current reports and lists. (Gentry-North Carolina)

W76-13040

**URBAN HYDROLOGY FOR SMALL WATERSHEDS.**

Soil Conservation Service, Washington, D. C. Engineering Div.  
For primary bibliographic entry see Field 4C.  
W76-13044

**MORE WATER: ONE CITY'S PLAN.**

Henningson, Durham and Richardson, Inc., Henderson, Tex.  
For primary bibliographic entry see Field 6D.  
W76-13097

**3E. Conservation In Industry****WATER FOR INDUSTRIAL AND AGRICULTURAL DEVELOPMENT IN COAHOMA, DE SOTO, PANOLA, QUITMAN, TATE, AND TUNICA COUNTIES, MISSISSIPPI.**

Geological Survey, Jackson, Miss.  
G. J. Dalsin, and J. M. Bettendorff.  
Mississippi Research and Development Center, Jackson, Miss., 1976. 87 p, 27 fig, 16 tab, 39 ref, append.

Descriptors: \*Water resources development, \*Industrial water, \*Agriculture, \*Mississippi, \*Hydrologic data, Water utilization, Surface waters, Groundwater, Streamflow, Aquifer characteristics, Water yield, Water wells, Hydrogeology, Water quality, \*Water supply, Available water, Projections, Surface-ground-water relationships.

Identifiers: Northwest Mississippi.

Ground water is the major source of industrial and agricultural water supplies in Coahoma, De Soto, Panola, Quitman, Tate, and Tunica Counties, Miss. 33 million gallons per day (mgd) were used

for public and industrial supply in 1973; irrigation use for the year was 39,000 acre-feet. Average runoff contributed to river basins in the study area is 2,600 mgd. The average flow of the Mississippi River is 297 billion gallons per day. Sardis, Enid, and Arkabutla Lakes have a combined conservation storage of 197,000 acre-feet and can hold more than 2.5 million acre-feet. The fresh-groundwater section is 800 to 3,000 feet thick. Tertiary aquifers, the major source of public, industrial, and domestic water supplies, are capable of supplying 1 million gallons of water per day or more to well fields in most places. The Mississippi River valley alluvial aquifer supplies water for irrigation, cooling, and industrial uses. Well fields can supply several million gallons per day. Ground water is highly mineralized in down dip areas of the Tertiary aquifers. Iron and low pH cause problems locally in water supplies. Water in the Mississippi River valley alluvial aquifer is hard and contains excessive iron. (Woodard-USGS)

W76-12798

**A PLAN FOR STUDY OF WATER AND ITS RELATION TO ECONOMIC DEVELOPMENT IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING.**

Geological Survey, Cheyenne, Wyo.  
For primary bibliographic entry see Field 6D.  
W76-12805

**CONSERVATION: EESG BIBLIOGRAPHY SERIES: 16.**

Reading Univ. (England). Dept. of Economics.  
For primary bibliographic entry see Field 6B.  
W76-12953

**WATER REQUIRED TO DEVELOP GEOTHERMAL ENERGY.**

Texas University at Austin. Geothermal Studies.  
M. H. Dorfman.  
American Water Works Association Journal, Vol. 68, No. 7, p 370-374, July 1976. 7 fig, 22 ref.

Descriptors: \*Geothermal studies, \*Temperature, \*Thermal properties, Environmental effects, Brines, Boron, Potash, Lithium, Land subsidence, Potable water, Geysers, Hot springs, Steam, Subsurface waters, Drilling equipment, Drilling fluids, California, \*Energy. Identifiers: Vapor-dominated connective systems, Liquid-dominated connective systems, High-enthalpy brines, Low-enthalpy fluids, Geopressed sands, Continental plates, Plate tectonics, Subduction zones, Crustal spreading, Italy, Mexico.

World wide distribution of geothermal resources may be identified within the framework of geologic mode of occurrence. Vapor-dominated connective systems are found in areas of plate convergence. Liquid-dominated connective systems, made up of high-enthalpy brines, are found in areas of crustal spreading. Low-enthalpy fluids are found at moderate to great depths in geopressed sands in subsiding sedimentary basins. Water needs for development of geothermal resources are minimal and are usually available. Water production presents varied problems however, depending upon the type of geothermal system. Vapor systems are sulfur rich and require protection against corrosion. Hot brines found in liquid systems are chlorine rich and require scaling and corrosion protection. Large-scale geothermal development may lead to development of mineral-extraction industries. Vapor system fluids are often rich in boron compounds and liquid system brines contain potash, lithium and other useful minerals. Potable water for irrigation may become an important by-product geothermal energy development. Subsidence problems from geothermal fluids will require additional research to determine the extent of the problem and develop methods of mitigating its effects. Geothermal areas appear to represent a useful source of energy

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3E—Conservation In Industry

with worldwide distribution. It is anticipated that geothermal energy will represent an increasing fraction of total energy supply as petroleum availability diminishes. (Heiss-NWWA)  
W76-13030

#### ENVIRONMENTAL CONTROL IN PLANTS AT MINIMUM COST.

For primary bibliographic entry see Field 5D.  
W76-13056

#### SHRIMP SUPPLIES IN THE SOUTHEAST AND THEIR EFFECT ON PROCESSING FIRM SIZE.

Florida Univ., Gainesville. Dept. of Food and Resource Economics.  
For primary bibliographic entry see Field 6C.  
W76-13103

### 3F. Conservation In Agriculture

#### EFFECTIVENESS OF INORGANIC FERTILIZERS IN RESTORING FERTILITY OF IRRIGATION-ERODED SOILS. (IN RUSSIAN).

Uzbekskii Gosudarstvennyi Universitet, Samar-kand (USSR).  
K. K. Khamdamov, and I. Berdikulov.

Dokl Vses (Ordina Lenina) Akad S-KH Nauk Im V I Lenina. 4, p 13-14, 1974.

Descriptors: \*Fertilizers, \*Inorganic compounds, \*Soil erosion, \*Crop production, Irrigation, Nutrients.  
Identifiers: Millet.

Application of inorganic fertilizers increases the crop-producing ability of these soils. The vegetative mass of millet and its root weight do not directly correlate with its yield. This was attributed to changes in the content of soil nutrients and physical properties of eroded and uneroded soils. Copyright 1975, Biological Abstracts, Inc.  
W76-12785

#### WATER FOR INDUSTRIAL AND AGRICULTURAL DEVELOPMENT IN COAHOMA, DE SOTO, PANOLA, QUITMAN, TATE, AND TUNICA COUNTIES, MISSISSIPPI.

Geological Survey, Jackson, Miss.  
For primary bibliographic entry see Field 3E.  
W76-12798

#### INVESTIGATIONS ON THE WATER REGIME OF THE MAIN SOIL TYPES OF THE CRIS RIVER PLAIN. (IN ROMANIAN).

Institutul de Studii si Cercetari Pedologie, Bucharest (Romania).  
For primary bibliographic entry see Field 2G.  
W76-12856

#### SOME HISTORICAL DATA ON THE ANTIQUITY OF SOIL IRRIGATION IN THE AZERBAIJAN SSR. (IN RUSSIAN).

Sh. G. Gasanov.  
Izv Akad Nauk Az SSR Ser Biol Nauk. 5-6, p 63-68, 1974.

Descriptors: \*Irrigation practices, \*History, Irrigation ditches, Irrigation canals.  
Identifiers: Azerbaijan-SSR, USSR.

The Azerbaidzhan-SSR (USSR) is a land of ancient agriculture where, by means of a system of canals, irrigation ditches and tunnels, the soils of the lowland and plain regions have been irrigated since 1500 B.C. Data on the history of irrigation and development of soils for irrigated crops in Azerbaidzhan are presented. Copyright 1976, Biological Abstracts, Inc.  
W76-12917

#### EFFICIENCY OF NITROGEN, CARBON, AND PHOSPHORUS RETENTION BY SMALL AGRICULTURAL RESERVOIRS.

Agricultural Research Service, Oxford, Miss. Sedimentation Lab.  
For primary bibliographic entry see Field 4D.  
W76-12983

#### SEDIMENT FROM DRAINAGE SYSTEMS FOR A HEAVY SOIL.

Ohio State Univ., Columbus. Dept. of Agricultural Engineering.  
G. O. Schwab, B. H. Nolte, and R. D. Brehm.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 7 p, 3 fig, 2 tab, 10 ref. ASAE Paper 75-2549

Descriptors: \*Sediment discharge, \*Sediment load, \*Sediment transport, \*Sediment yield, \*Drainage, Drainage practices, \*Drainage systems, Drains, Ohio, Tile drains, Soils.

Sediment losses from tile and surface drainage systems in a lakebed soil in northern Ohio were measured for 6 years (1969-74). Average annual losses were 2369 Kgs/Ha from tile only and 3710 Kgs/Ha for surface only. Expected losses for the combination tile and surface drainage system were 3260 Kgs/Ha. Losses ranged from about 200 to 900 Kgs/Ha annually. Average net losses from sprinkler irrigation were negligible and usually more sediment was added than removed in the drainage water. Sediment concentration in tile flow from irrigation increased significantly with the antecedent soil moisture content. Concentrations were high at the beginning of flow but decreased to a nearly constant level after 20 hours. A possible explanation for the high concentrations is that the sediment moved in suspension with the water and not through the soil cracks. The total estimated soil loss from the surface drained only plots was within one percent of the measured losses. The estimated losses were computed from the universal soil loss equation. For the no-till plots the estimated losses were 16 percent higher than than the measured whereas conventional tillage losses were 11 percent lower. A linear regression was significant at the 99% level. Estimates using ant runoff factor rather than the rainfall factor in the soil loss equation were 41 percent of the measured values compared to 89 percent using the rainfall factor. (Skogerboe-Colorado State)  
W76-13001

#### IRRIGATION SCHEDULING AND SUGARBEET PRODUCTION.

Northern Ohio Sugar Co., Fremont, Ohio.  
G. D. Jardine, and S. D. Fox.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 6 p, 4 tab, 6 ref. ASAE Paper 75-2556.

Descriptors: \*Sugarbeets, Irrigation, Irrigation practices, Crop response, Colorado, Soil moisture, Irrigation efficiency, \*Scheduling, Crop production.  
Identifiers: \*Irrigation scheduling.

Irrigation scheduling and sugarbeet production are discussed. The emphasis is upon the results of Great Western Sugar Company's irrigation studies and the recommendations for a successful sugarbeet irrigation program. Recommendations are: (1) begin the season with a full or nearly full soil moisture profile; (2) give the crop a boost with light irrigations for emergence and after thinning, if necessary; (3) schedule irrigations throughout the season using climate, crop, and soil data. Also, include the irrigators experience and habits where possible in determining the actual schedule; and (4) utilize irrigation scheduling to determine the cut-off dates for late season irrigations. These recommendations all point toward managing the soil moisture so the maximum sugar production

can be attained by utilizing all the resources available to the grower. Today's sugarbeet grower must be a good manager. All tools researchers can provide to better manage irrigations will help insure the continued production of high yielding, high quality, sugarbeets. (Skogerboe-Colorado State).  
W76-13002

#### TRICKLE AND SPRINKLER IRRIGATION OF GRAIN SORGHUM.

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.  
C. J. Ravelo, E. A. Hiler, and T. A. Howell.  
Presented at the 1975 Winter Meeting of the American Society of the Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 17 p, 5 fig, 3 tab, 15 ref. ASAE Paper 75-2574.

Descriptors: \*Crop response, \*Sorghum, \*Irrigation practices, \*Irrigation effects, \*Sprinkler irrigation, Irrigation systems, \*Grain sorghum.  
Identifiers: \*Drip irrigation, \*Trickle irrigation, Irrigation frequency.

The crop response and water use efficiency (ratio of weight of grain harvested to centimeters of total crop water use) of grain sorghum was investigated using trickle and sprinkler irrigation. Also the effects of different trickle irrigation frequencies on the crop growth and ultimate grain yield were studied. Two different experimental investigations are reported one conducted in 1972 and another in 1974. The 1972 sprinkler vs. trickle experiment had the following two irrigation treatments with three replications each: (1) trickle irrigated three times per week, and (2) overhead sprinkler irrigated three times per week. The irrigation amounts in each treatment were 1.1 times soil water losses as measured by the neutron method with gravimetric sampling in the upper 10 cm. The 1974 trickle irrigation frequency experiment had the following three treatments with three replications each: (1) trickle irrigated three weekly, (2) trickle irrigated twice weekly, and (3) trickle irrigated once weekly. From the results of these experimental investigations and for the given conditions of this study, the following conclusions can be drawn: (1) There were no significant differences in yield or water use efficiency when using trickle and sprinkler irrigation with a three-weekly frequency; and (2) Different trickle irrigation frequencies (once, twice, and three weekly) with the same overall application amounts had no significant effect on grain sorghum yield or water use efficiency. (Skogerboe-Colorado State).  
W76-13003

#### SPRINKLER EVAPORATION LOSSES IN THE SOUTHERN PLAINS.

Southwestern Great Plains Research Center, Bushland, Tex.  
R. N. Clark, and W. W. Finley.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 11 p, 5 fig, 6 ref. ASAE Paper 75-2573.

Descriptors: \*Sprinkler irrigation, \*Evaporation, \*Irrigation, \*Irrigation effects, Water conservation, Wind velocity, \*Great Plains.  
Identifiers: Southern Great Plains.

Water discharged from irrigation sprinklers was caught in specially designed containers in order to determine evaporation losses during sprinkling. Two nozzle sizes and three water pressures were tested during the study period. When the average wind velocity was less than 4.5 m/s (10 mph), the evaporation losses were generally less than 10% and the vapor pressure deficit had the greatest influence on the amount of evaporation. When average wind velocities were between 4.5 m/s and 8.5 m/s, losses increased exponentially with wind velocity. The wind velocity was the predominate factor under these conditions and evaporation



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losses ranged from 10 to 30%. Since much of the Southern Plains has an annual average wind velocity greater than 6 m/s, average evaporation losses can be expected to exceed 15%. (Skogerboe-Colorado State).  
W76-13004

### SPRINKLER IRRIGATION PERCOLATION LOSSES

Agricultural Research Service, Morris, Minn. A. S. Dylla, and H. Shull. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 8 p, 1 tab, 3 equ, 6 ref. ASAE Paper 75-2572.

Descriptors: \*Sprinkler irrigation, \*Percolation, \*Percolating water, Irrigation, Soil water, Soil water movement, Irrigation effects, Uniformity coefficient, Estimating.

A workable procedure is presented for estimating sprinkler irrigation percolation losses. The method is based on the amount of water applied, the soil moisture deficit, and the sprinkler distribution uniformity coefficient. (Skogerboe-Colorado State)  
W76-13005

### SAMPLERS FOR MONITORING RUNOFF WATERS

Kansas State Univ., Manhattan. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5A.  
W76-13006

### PORTABLE, ADJUSTABLE FLOW-MEASURING FLUME FOR SMALL CANALS

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab. For primary bibliographic entry see Field 4A.  
W76-13007

### REDUCED IRRIGATION TAILWATER RUNOFF FOR INCREASED WATER-USE EFFICIENCY

Southwestern Great Plains Research Center, Bushland, Tex. A. D. Schneider, L. L. New, and J. T. Musick. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 18 p, 4 fig, 4 tab, 8 ref. ASAE Paper 75-2541.

Descriptors: \*Return flow, \*Irrigation effects, \*Irrigation practices, \*Tailwater, Water conservation, Irrigation water, \*Water utilization, Sorghum.  
Identifiers: \*Water use efficiency.

Duration of tailwater runoff from 570-m long graded furrows did not significantly affect field average yields of grain sorghum grown on a slowly permeable soil. Irrigation water-use efficiency varied inversely with the time of tailwater runoff. Conclusions were: (1) The field average grain sorghum yield on 570-m long irrigated furrows of Pullman clay loam was not seriously affected by tailwater runoff duration. Major yield reduction occurred only in the lower 180 m of the field; (2) Limiting or reducing tailwater runoff increases the irrigation water-use efficiency of grain sorghum grown on graded-furrow irrigated Pullman clay loam. The results should be applicable to other drought-resistant crops on similar soil; and (3) A limited tailwater runoff irrigation procedure permits irrigating larger acreages with a fixed water supply. (Skogerboe-Colorado State)  
W76-13008

### DRAINAGE MAINTENANCE PROGRAMS IN OHIO COUNTIES

Ohio State Univ., Columbus. Cooperative Extension Service.

For primary bibliographic entry see Field 4A.  
W76-13009

### PHYSICAL-CHEMICAL COMPOSITION OF ERODED SOIL

Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2J.  
W76-13010

### LEAF WATER POTENTIAL AND MOISTURE BALANCE—FIELD DATA

Agricultural Research Service, Auburn, Ala.; and Alabama Agricultural Experiment Station, Auburn. For primary bibliographic entry see Field 2J.  
W76-13011

### MEETING FUTURE WATER REQUIREMENTS BY WATER CONSERVATION

Soil Conservation Service, Golden, Colo. J. D. Hedlund. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 10 p, 2 fig, 3 tab. ASAE Paper 75-2557.

Descriptors: \*Water conservation, Irrigation, \*Irrigation practices, \*Water demand, Water utilization, Irrigation efficiency, Irrigation water, Water quality, Return flow, Water supply, \*Water requirements.

Applying best management practices available to irrigation could (1) reduce 1975 withdrawals of 195 million acre-feet by 48 million acre-feet, (2) salvage 8 million acre-feet of incidental losses, (3) reduce pollutant-laden return flow by 47 million acre-feet and (4) meet year 2000 production demands. (Skogerboe-Colorado State)  
W76-13013

### FACTORS INFLUENCING THE LOSS OF NITROGEN AND PHOSPHORUS FROM A TRACT OF IRRIGATED LAND

Idaho Univ., Moscow. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5G.  
W76-13014

### ESTABLISHING WATER, NUTRIENT AND TOTAL SOLIDS MASS BUDGETS FOR A GRAVITY-IRRIGATED FARM

Idaho Univ., Moscow. Dept. of Agricultural Engineering. D. W. Fitzsimmons, J. R. Busch, G. C. Lewis, D. V. Naylor, and R. D. Carlson. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 15 p, 3 fig, 5 tab, 5 ref. ASAE Paper 75-2544.

Descriptors: \*Irrigation, \*Irrigation practices, Furrow irrigation, \*Surface irrigation, Evapotranspiration, Nutrients, Leaching, Return flow, Water pollution, \*Computer models.  
Identifiers: \*Mass budgets(Total solids).

Mass budgets were established for a surface-irrigated farm and used to determine net losses of water, nutrients and solids from the farm. Data for establishing the budgets were obtained by monitoring surface flows and groundwater during two irrigation seasons. Flow and chemical analysis data were combined, using a computer model, to obtain the budgets. (Skogerboe-Colorado State)  
W76-13015

### IRRIGATION REUSE SYSTEMS—A PROPOSED NEW ASAE ENGINEERING PRACTICE

Colorado State Univ., Fort Collins. Dept. of Agricultural. For primary bibliographic entry see Field 3C.

W76-13016

### SUSPENDED SEDIMENT AND TURBIDITY IN IRRIGATION RETURN FLOWS - A PROTOTYPE STUDY

Soil Conservation Service, Spokane, Wash. For primary bibliographic entry see Field 5B.  
W76-13017

### DEFLECTION-STIFFNESS CHARACTERISTICS OF CORRUGATED PLASTIC TUBING

Ohio Agricultural Research and Development Center, Columbus. For primary bibliographic entry see Field 4A.  
W76-13018

### PREDICTED VERSUS MEASURED DRAINABLE POROSITIES

North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering. For primary bibliographic entry see Field 4A.  
W76-13019

### AN EXPERIMENT WITH A LINEARLY INCREASING SPACING OF SUBSURFACE DRAINS

Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering. For primary bibliographic entry see Field 4A.  
W76-13020

### EFFECT OF OPENINGS ON INFLOW INTO CORRUGATED DRAINS

Ohio Agricultural Research and Development Center, Columbus. For primary bibliographic entry see Field 4A.  
W76-13021

### TILLAGE, MATRIC POTENTIAL, OXYGEN AND MILLET YIELD RELATIONSHIPS IN A LAYERED SOIL

Agricultural Research Service, Florence, S.C. Coastal Plains Soil and Water Conservation Research Center. R. B. Campbell, and C. J. Phene. Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 17 p, 6 fig, 17 ref. ASAE Paper 75-2535.

Descriptors: \*Oxygen, \*Crop response, \*Soil tests, Soil investigations, Soil environment, Soil horizons, Soil moisture, \*Cultivation.  
Identifiers: \*Tillage effects, \*Matric potential, \*Millet.

A unique relationship was established between soil O<sub>2</sub> content and soil water matric potential from which the O<sub>2</sub> content may be estimated from soil matric potential data. Yield of millet was a function of soil O<sub>2</sub> content from 2 to approximately 15%. At soil O<sub>2</sub> levels greater than 15%, the growth of millet was independent of soil O<sub>2</sub> content. Harvesting millet twice during the growing season which included a 14-day wet period produced significantly greater yields than harvesting three times. Chiseling the soil 35 cm deep one year before the experiment resulted in yields greater than those of the plowed soil, when the soil was in a wet condition, simulating a stormy 14-day period. Under a moderate soil water regime, in which the soil matric potential did not exceed -400 mb, aeration was adequate and the yield of millet was unaffected by tillage depth. Under high matric potential conditions, -45 to -87 mb, chiseling was beneficial as a means of partially alleviating soil oxygen stresses associated with a wet soil condition. (Skogerboe-Colorado State)  
W76-13022

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation In Agriculture

**SOIL MOISTURE REGIME WITH SUBIRRIGATION,**  
Universidad del Valle, Cali (Colombia).  
For primary bibliographic entry see Field 2G.  
W76-13023

**PLANT WATER STRESS CRITERIA FOR IRRIGATION SCHEDULING,**  
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 2G.  
W76-13024

**ENGINEERED IRRIGATION WELLS.**  
For primary bibliographic entry see Field 4B.  
W76-13033

**WATER USE BY DRYLAND CORN AS AFFECTED BY MATURITY CLASS AND PLANT SPACING,**  
Agricultural Research Service, Mandan, N. D. Northern Great Plains Research Center.  
J. Alessi, and J. F. Power.  
Agronomy Journal, Vol. 68, No. 4, p 547-500, July-August 1976. 3 fig, 4 tab, 12 ref.

Descriptors: \*Water utilization, \*Corn(Field), \*Mature growth stage, \*Crop response, Crop production, Soil water, Evapotranspiration, Plant populations, Soil-water-plant relationships, Efficiencies.

A study was conducted at Mandan, N. D., to determine the effects of row spacing and plant population on growth and water use by early dryland corn (Zea mays L.) hybrids. For 3 years, 68- and 85-day relative maturity class hybrids were grown at plant populations of 20, 30, 40, 60 and 74 thousand plants/ha in 50- and 100-cm rows on Temvik silt loam (Typic haploboroll). Soil water content was not affected by row spacing or location of the access tube with respect to the row. Water withdrawal by the crop was usually in the upper 90-cm soil depth, regardless of treatment. Greater populations generally increased water use during vegetative growth, leaving less water for reproductive growth. Soil water depletion was greater during the early growing season than after midseason when water use was highly dependent on precipitation. Water use efficiency was highest at a population of 40,000 plants, except for dry-matter production by the 85-RM hybrid at the largest population. The early maturing hybrid was more efficient in water use for grain production, while the later maturing hybrid was more efficient for forage production. The early maturing hybrid may also be less affected by severe drought. (Jahns-Arizona)  
W76-13124

**ASPECTS OF SOIL SALINITY AND SODICITY IN RELATION TO IRRIGATION AND RECLAMATION,**  
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Dept. of Soil and Water.  
For primary bibliographic entry see Field 3C.  
W76-13126

**COMBINED IRRIGATION AND FERTILIZATION OF TOMATOES GROWN ON SAND DUNES,**  
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Chemistry and Plant Nutrition.  
For primary bibliographic entry see Field 3C.  
W76-13127

**RANGE FERTILIZATION IN THE NORTHERN GREAT PLAINS,**  
Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center.  
For primary bibliographic entry see Field 4A.  
W76-13131

**GENOTYPE VARIATION IN NUTRIENT UPTAKE EFFICIENCY IN CORN,**  
New York State Univ. Agriculture and Technology Coll. at Cobleskill.  
T. F. Bruetsch, and G. O. Estes.  
Agronomy Journal, Vol. 68, No. 3, p 521-523, May-June 1976. 2 tab, 19 ref.

Descriptors: \*Corn(Field), \*Plant growth, \*Nutrient requirements, Mature growth stage, Phosphorus, Root systems, Root development, \*Absorption.  
Identifiers: \*Nutrient uptake(Corn), Dry matter.

Nutrient uptake varied significantly for 12 corn genotypes of commercial importance and of varying maturity under field conditions. Relative maturity was based on the percentage of dry matter (% DM) after 115 days of growth. There were significant positive correlations between % DM and foliage P concentration and content, indicating that earlier maturing genotypes had higher P levels. Genotypes varied in terms of dry weight production per gram of N, P, K, Ca and Mg absorbed, with the relationship between P concentration and relative maturity being most consistent. A significant negative correlation between % DM and DM/g of P absorbed indicated more efficient P use by the later maturing corn lines in terms of dry matter production. Such response may be due to the ability of roots to penetrate soil and physically contact more soil P. (Jahns-Arizona)  
W76-13134

**IRRIGATION SYSTEM CONTROLLER,**  
International Electric Corp., Chicago, Ill. (Assignee).  
C. K. Sears.  
U. S. Patent No. 3,961,753, 11 p, 8 fig, 10 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 655-656, June 8, 1976.

Descriptors: \*Patents, \*Irrigation, \*Irrigation systems, \*Distribution systems, \*Irrigation efficiency, \*Monitoring, Instrumentation, Orchards, Citrus fruits, Moisture content, Moisture meters.  
Identifiers: Drip irrigation.

An irrigation system controller operationally ties the dispensing of water to the soil directly to its need without requiring continuous monitoring by the irrigation manager. If a preselected water supply period is not sufficient to attain a desired moisture content in the soil due either to an insufficient estimate on the part of the manager or a power or equipment failure or unforeseen change in weather, a warning device or other electrically-operated signal calls attention to the need for the selection of a new longer water supply period or a correction of the power or equipment failure. A pushbutton switch resets the warning system. If the preselected water supply period is sufficient to maintain the desired moisture content, a feed-back loop automatically controls the dispensation of water to maintain the desired moisture content of the soil. (Sinha-OEIS)  
W76-13137

**LAWN SPRINKLING AND SIMILAR INSTALLATIONS,**  
Carpano and Pons S.A. (France). (Assignee).  
M. Chauvigne.  
U. S. Patent No. 3,964,685, 5 p, 11 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1624, June 22, 1976.

Descriptors: \*Patents, \*Irrigation, \*Sprinkler irrigation, \*Irrigation efficiency, Irrigation practices, Water distribution(Applied), Automatic control, Application equipment.

A lawn sprinkling installation has a series of dosing valves arranged in cascade to each successively deliver a set quantity of water to a sprinkler. Each dosing valve has a hinged clapper biased to normally open a first outlet leading to the sprinkler

and close a second outlet connected to the inlet of the successive dosing valve. Volumetric dosing means hold each clapper to close the first outlet and open the second after delivery of a regulated quantity of water and hold the clapper as long as the water pressure is maintained. When the last dosing valve shuts off supply to the last sprinkler, a gate valve supplying the first dosing valve is automatically or manually closed to allow water in the pipes joining the dosing valves to drain through a discharge orifice, thus enabling automatic resetting of the clappers. (Sinha-OEIS)  
W76-13157

**LAWN, FARM, AND ORCHARD SPRINKLERS,**  
K. T. Sheets.  
U. S. Patent No. 3,964,688, 7 p, 16 fig, 6 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1625, June 22, 1976.

Descriptors: \*Patents, \*Irrigation, \*Sprinkler irrigation, \*Irrigation efficiency, Irrigation practices, Water distribution(Applied), Application equipment.

The invention relates to projectable sprinklers with a rotating nozzle or nozzles which are automatically projected or advanced to a position above the surrounding ground level when water is supplied under pressure to the sprinkler; to sprinkler heads which can be used on a projectable or non-projectable sprinkler; to stationary sprinklers for use on the surface of the ground; and to an apparatus for increasing the area wetted by a sprinkler. The projectable sprinklers include a projectable float having a sprinkler head attached to the top end, a housing in which the projectable float moves, and a water supply attached to the sprinkler head. The apparatus for increasing the wetted area around the sprinkler includes a disc mounted on top of a sprinkler head having a movable flap. (Sinha-OEIS)  
W76-13158

**THE USE OF LINEAR PROGRAMMING TECHNIQUES FOR ESTIMATING THE BENEFITS FROM INCREASED ACCURACY OF WATER SUPPLY SYSTEMS,**  
Battelle Memorial Inst., Columbus, Ohio.  
For primary bibliographic entry see Field 6A.  
W76-13169

## 4. WATER QUANTITY MANAGEMENT AND CONTROL

### 4A. Control Of Water On The Surface

**A NON-LINEAR PROGRAMMING MODEL FOR EVALUATING WATER SUPPLY POLICIES IN THE TEXAS COASTAL ZONE,**  
Texas Univ. at Austin.  
For primary bibliographic entry see Field 6D.  
W76-12680

**AN EVALUATION OF TWO HYDROGRAPHIC SEPARATION METHODS OF POTENTIAL USE IN REGIONAL WATER QUALITY ASSESSMENT,**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5G.  
W76-12691

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.

W76-12787

**LAND-USE CLASSIFICATION MAP OF THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12788

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12789

**LAND-USE CLASSIFICATION MAP OF THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12790

**MAP OF ROCK TYPES IN BEDROCK OF ALLEGHENY COUNTY, PENNSYLVANIA,**  
Geological Survey, Harrisburg, Pa.  
For primary bibliographic entry see Field 7C.  
W76-12791

**HYDROLOGIC UNIT MAP—1974, STATE OF MONTANA,**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-12793

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12796

**HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS METROPOLITAN AREA, 1974,**  
Geological Survey, Austin, Tex.  
For primary bibliographic entry see Field 7C.  
W76-12804

**A BRIEF HYDROLOGIC APPRAISAL OF THE JULY 3-4, 1975, FLASH FLOOD IN LAS VEGAS VALLEY, NEVADA,**  
Geological Survey, Carson City, Nev.  
T. L. Katzer, P. A. Glancy, and L. Harmsen.  
Open-file report 76-100, 1976. 40 p, 22 fig, 1 plate, 2 tab, 2 ref.

**Descriptors:** \*Flash floods, \*Flood data, \*Flood peak, \*Sediment transport, \*Flood damage, Flood discharge, Storm runoff, Thunderstorms, Data collections, Hydrographs, Aerial photography, Maps, \*Nevada.  
**Identifiers:** \*Las Vegas Valley(Nev), Tropicana Wash, Flamingo Wash, Las Vegas Creek.

Heavy thunderstorm precipitation on the afternoon of July 3, 1975, between metropolitan Las Vegas and the mountains to the south, west, and north, caused flash flooding in the city area. Total storm precipitation equaled or exceeded 3 inches in some areas. The total storm yield on the area of significant runoff was probably between 20,000 and 25,000 acre-feet of water. Of this amount, probably less than 3,000 acre-feet flowed directly to Lake Mead. Peak flows of Tropicana Wash,

Flamingo Wash, Las Vegas Creek, and Las Vegas Wash were the highest ever determined. Flooding caused the loss of two lives and inflicted extensive property damage. Total damage was reportedly estimated by the Clark County Flood Control District at \$4-5 million. Problems associated with sediment erosion, transportation, and deposition occurred throughout the flooded area. An unknown amount of the material transported during the flood was deposited in Lake Mead near the mouth of Las Vegas Wash. Lateral erosion appeared more prominent than vertical erosion along most major channels, except on Las Vegas Wash at Northshore Road where downcutting threatened the loss of the highway. Sediment deposits were particularly noticeable and troublesome in Flamingo Wash at Caesars Palace parking lot and on the Winterwood Golf Course near the junction of Flamingo Wash and Las Vegas Wash. (Woodard-USGS)  
W76-12806

**SELECTED EFFECTS OF SUBURBAN DEVELOPMENT ON RUNOFF IN SOUTH-COASTAL, CALIFORNIA.**  
Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 4C.  
W76-12810

**PLAN OF WORK, RED RIVER BASIN ABOVE DENISON DAM.**  
Soil Conservation Service, Temple, Tex.  
Type IV Cooperative River Basin Survey, July 1975. 60 p, 2 fig.

**Descriptors:** \*River basins, \*Surveys, \*Planning, \*Texas, \*Oklahoma, Rivers, Watersheds(Basins), Dams, Basins, Water supply, Water quality, Surface waters, Water resources, Agriculture, Forests, Drainage, Economics, Recreation, Land use, Environment, Evaluation, Projects, River basin development.  
**Identifiers:** \*Red River Basin(Tex-Okla), \*Denison Dam(Tex-Okla).

The Red River Basin Above Denison Dam extends from eastern New Mexico across the Texas Panhandle to Denison Dam on the Oklahoma-Texas boundary. In 1970 and 1971, the U.S. Department of Agriculture received requests from the Oklahoma Conservation Commission, the Oklahoma Water Resources Board, the Texas Water Development Board, the Texas State Soil and Water Conservation Board, and the Texas Water Rights Commission to participate in a Type IV cooperative study of the Red River Basin Above Denison Dam. The overall objective of the study was to determine the capability of water and land resource projects and programs for solving problems and meeting needs of the basin. The U.S. Department of Agriculture agreed to participate under the authority and provisions of Section 6 of Public Law 83-566, as amended. It was essential that plans for water and land resource development in the Red River Basin Above Denison Dam be compatible with the principles, objectives, plans, and programs in Oklahoma and Texas, respectively. It was also essential that the plans finally developed be compatible with efficient and effective land treatment programs, water management, administration, and supervision under applicable State and Federal authorizations and responsibilities. (Sims-ISWS)  
W76-12816

**A CONDUCTIVITY FLOW METER,**  
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.; and Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.  
For primary bibliographic entry see Field 7B.  
W76-12825

**A MATHEMATICAL MODEL FOR FLOOD-WAVE FORECASTING BY MEANS OF WARNING BASINS,**  
Institutul de Meteorologie si Hidrologie, Bucharest (Romania).  
C. Diaconu, and V. Al. Stanescu.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 77-80, March 1976. 1 fig, 1 tab.

**Descriptors:** \*Mathematical models, \*Flood waves, \*Basins, \*Forecasting, Model studies, Runoff, Warning systems, Precipitation, Hydrologic cycle, Equations, Runoff forecasting.  
**Identifiers:** \*Target basin, \*Romania, \*Flood wave forecasting, \*Mures River, Warning basins, Fortran IV, Precipitation components.

An approach was proposed to eliminate the difficulties surrounding the direct use of precipitation components to forecast runoff. Precipitation data and runoff coefficients were obtained for small selected warning basins in the forecast area (target basin), and the runoff from the warning basins was accurately determined. These values were routed into the runoff values of the target basin using a modified isochrone method. The damping effect of the flow of the network was taken into account. An algorithm for the runoff of the target basin was given. The computation was done using Fortran IV, and examples of computed and actual hydrographs were given for the flood on the Mures River in May 1970. (Roberts-ISWS)  
W76-12829

**COMPARISON OF REQUIRED RESERVOIR STORAGE COMPUTED BY THE THOMAS-FIERING MODEL AND THE 'KARLSRUHE MODEL' TYPE A AND B,**  
Karlsruhe Univ. (West Germany). Institut fuer Wasserbau III.  
B. Treiber, and G. A. Schultz.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p 177-185, March 1976. 5 fig, 4 tab, 6 ref.

**Descriptors:** \*Reservoir storage, \*Synthetic hydrology, \*Model studies, Computers, \*Reservoir yield, Laboratory tests, Graphical analysis, Flows, Hydrologic data, Analytical techniques, Hydrology.  
**Identifiers:** \*Thomas-Fiering model, \*Karlsruhe model, \*Black Forest mountains, Hurst coefficient.

Design of water supply reservoirs, i.e. the determination of required reservoir capacity, often requires use of the Rippl method on the basis of observed monthly flow data. This technique has two major drawbacks: (1) the observed data are subject to sampling errors influencing the design results, (2) the coarse time discretization produces too small required reservoir capacities. In order to reduce the sampling errors, designs are often based on many time series of synthetically generated data. There are several models available which generate monthly flow data. The results when using the Thomas-Fiering model and when using the Karlsruhe generating model, type A, were compared. Reservoir capacities were also determined using Karlsruhe model, type B, for daily flows. For a reservoir in the Black Forest Mountains in south Germany, the reservoir capacities were shown to be higher with the Thomas-Fiering model and lower with the Karlsruhe model than those capacities given by the 45 years historical data of monthly flows. When the Karlsruhe model with daily flows was used, the desired capacities at full development were about 2 to 5% higher than with the monthly flows. The capacities were shown to be substantially higher with daily flows if the level of development was only 44%. (Singh-ISWS)  
W76-12832



## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**ATMOSPHERIC INPUT OF SOME CATIONS AND ANIONS TO FOREST ECOSYSTEMS IN NORTH CAROLINA AND TENNESSEE.**  
Forest Service (USDA), Franklin, N.C. Coweeta Hydrologic Lab.

For primary bibliographic entry see Field 2K.  
W76-12838

**MAJOR JUNCTION STRUCTURE VERIFIED BY MODELING.**  
Santa Barbara County Water Agency, Los Angeles, Calif.

For primary bibliographic entry see Field 8B.  
W76-12840

**URBAN STORMWATER RUNOFF: DETERMINATION OF VOLUMES AND FLOWRATES.**  
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5B.  
W76-12858

**TIOGA RIVER MINE DRAINAGE ABATEMENT PROJECT.**  
Pennsylvania Dept. of Environmental Resources, Harrisburg.

For primary bibliographic entry see Field 5G.  
W76-12874

**COMPUTER HALTS FLOODING COMPLAINTS.**  
Waterman, Inc., Saint Paul, Minn.

For primary bibliographic entry see Field 5D.  
W76-12905

**EVALUATION OF THE REPORT ON INTERCEPTOR SEWERS AND SUBURBAN SPRAWL.**  
Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation.

For primary bibliographic entry see Field 5D.  
W76-12915

**IMPACTS OF RECREATIONAL DEVELOPMENT: THE VOYAGER VILLAGE EXPERIENCE.**  
Wisconsin Planning Office, Madison.

For primary bibliographic entry see Field 6B.  
W76-12965

**SELECTIVE WITHDRAWAL CRITERIA OF STRATIFIED FLUIDS.**  
Catholic Univ. of America, Washington, D. C. Dept. of Civil and Mechanical Engineering.

For primary bibliographic entry see Field 8B.  
W76-12970

**CLASSIFICATION AND ANALYSIS OF RIVER PROCESSES.**  
For primary bibliographic entry see Field 8B.  
W76-12973

**SHAPE AND SIZE OF ALLUVIAL CANALS.**  
Central Water and Power Research Station, Poona (India).

For primary bibliographic entry see Field 8B.  
W76-12975

**EFFECTS OF OVBANK FLOW IN FLOOD COMPUTATIONS.**  
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.

For primary bibliographic entry see Field 2E.  
W76-12976

**FLOODWATER RETARDING STRUCTURE YIELD IMPACT.**  
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.

E. H. Seely.

Transactions of the American Society of Agricultural Engineers, Vol. 19, No. 3, p 520-523, May-June 1976. 7 fig, 2 tab, 16 ref.

Descriptors: \*Flood protection, \*Watershed management, \*Water yield, \*Runoff, \*Oklahoma, \*Texas, Inflow, Outflow, Subsurface flow, Water conservation, Evaporation, Water loss.

Identifiers: \*Washita River, \*Floodwater retarding structure.

The upstream watershed-protection and flood-prevention program of the Soil Conservation Service is very important to agriculture. Knowledge of the magnitude of impact of the program on downstream runoff yield in water-scarce areas is also important. One of the primary program elements, the floodwater-retarding structure (FRS), has potential impact on yield of surface runoff. Reliable yield impact estimates are needed to protect downstream users and to avoid excessive restrictions on the upstream programs. Published information on downstream impact of FRS was reviewed and analyzed. The information found was neither satisfactory nor accurate enough for the Oklahoma-Texas area, where most of the structures and most of the concern about downstream impact are located. (Lardner - ISWS)  
W76-12978

**A MATHEMATICAL MODEL OF THE 'RESERVOIR' TYPE DESIGNED FOR FLOOD-WAVE MODELLING AND FORECASTING.**  
Institutul de Meteorologie si Hidrologie, Bucharest (Romania).

For primary bibliographic entry see Field 2A.  
W76-12979

**AN ADAPTIVE IDENTIFICATION AND PREDICTION ALGORITHM FOR THE REAL-TIME FORECASTING OF HYDROLOGICAL TIME SERIES.**  
International Inst. for Applied Systems Analysis, Laxenburg (Austria).

For primary bibliographic entry see Field 2A.  
W76-12980

**DATA ANALYSIS AND SYSTEM MODELLING IN URBAN CATCHMENT AREAS (IN THE NEW TOWN OF LELYSTAD, THE NETHERLANDS).**  
IJsselmeerpolders Development Authority, Lelystad (Netherlands). Scientific Div.

For primary bibliographic entry see Field 2A.  
W76-12981

**PORTABLE, ADJUSTABLE FLOW-MEASURING FLUME FOR SMALL CANALS.**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

J. A. Replogle.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 25 p. 5 fig, 2 appendix, 5 ref. ASAE Paper 75-2558.

Descriptors: \*Flow measurement, \*Flumes, \*Portability, \*Water measurement, Flow rates, Water conservation, Canals, \*Irrigation canals.

Identifiers: \*Portable flumes.

A portable flume-site survey flume was constructed and used to verify siting of permanent metering flumes. The portable system consists of a trapezoidal throat that can be raised and lowered in a flowing field ditch to establish limits of unsubmerged operation and backwater effects on upstream structures. Mechanical solutions to problems of maintaining gage-zero on a movable throat flume, stilling well readout, and movable seals between ditch and flume were presented. A family of concrete throat sections, differing only in height of installation from the flume floor, were recommended for the permanent installations.

Flows between about 0.5 cfs (0.01 m<sup>3</sup>/s) and 25 cfs (0.7 m<sup>3</sup>/s) can be measured with the portable system. Satisfactory operation can be achieved with less than 4 inches (10 cm) head loss to the canal system. Permanent structures can be installed with high assurance that they will operate as intended, be convenient enough to be routinely used and rugged enough to remain reliable and accurate. (Skogerboe - Colorado State)  
W76-13007

**REDUCED IRRIGATION TAILWATER RUNOFF FOR INCREASED WATER-USE EFFICIENCY.**

Southwestern Great Plains Research Center, Bushland, Tex.

For primary bibliographic entry see Field 3F.  
W76-13008

**DRAINAGE MAINTENANCE PROGRAMS IN OHIO COUNTIES.**  
Ohio State Univ., Columbus. Cooperative Extension Service.

B. H. Nolte.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 4 p, 2 tab, 7 ref. ASAE Paper 75-2502.

Descriptors: \*Drainage programs, \*Drainage engineering, \*Ohio, Cost analysis, \*Maintenance, \*Maintenance costs, \*Channel improvement.

Identifiers: \*Drainage system maintenance.

Drainage maintenance programs have increased dramatically in Ohio counties during the past 18 years. Over 11,000 km of channel are being maintained. It is estimated that an additional 970,000 hectares could have better drainage from future outlet construction and maintenance in Ohio. (Skogerboe - Colorado State)  
W76-13009

**DEFLECTION-STIFFNESS CHARACTERISTICS OF CORRUGATED PLASTIC TUBING.**  
Ohio Agricultural Research and Development Center, Columbus.

G. O. Schwab, and C. J. W. Drablos.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 11 p, 2 fig, 4 tab, 8 ref. ASAE Paper 75-2528.

Descriptors: \*Plastic, \*Plastic deformation, \*Plastic pipes, Drainage, Drainage practices, Equipment, Pipes, Ohio, Indiana, Illinois.

Identifiers: \*Corrugated plastic pipe.

Deflection of corrugated plastic tubing from replicated field tests and from farm installations in Ohio, Indiana, and Illinois was measured after one to four years following installation. Commercial tubing sizes varied from 102 to 381 mm (4 to 15 in.) in diameter. The purpose was to confirm present standards and to collect supporting data for development of standards for large-size tubing. In the replicated tests from two manufacturers 102-mm (4-in.) tubing deflection decreased nearly linearly with an increase in stiffness. Maximum deflections after 4 years were less than 17 per cent. All but one test sample was below ASTM F405-74 stiffness standards. About 80 per cent of the deflection occurred during the first two years with essentially no difference between the third and fourth year. Average differences in deflection for 60- and 120-degree groove angles were within 2 mm (0.08 in.) or less than the accuracy of measurement. (Skogerboe-Colorado-State)  
W76-13018

**PREDICTED VERSUS MEASURED DRAINABLE POROSITIES.**  
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.

R. W. Skaggs, L. G. Wells, and S. R. Ghate.

Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 20 p, 8 fig, 3 tab, 9 ref. ASAE Paper 75-2527.

Descriptors: \*Drainage engineering, \*Drainage practices, Drains, Soil water, Soil water movement, Cores, Soil tests, Soil investigations.

Experiments were conducted on large field cores to determine the relationship between drainage volume and water table depth for five soils. The measured drainage volumes were less than predicted from the soil water characteristics for all but one soil, for which measured and predicted results were in good agreement. Drainable porosities were calculated from both theoretical and experimental drainage volume-water table depth relationships by assuming that the unsaturated zone is essentially 'drain to equilibrium' to the water table. The experimental drainable porosities thus obtained were less than observed. (Skogerboe-Colorado State)

W76-13019

**AN EXPERIMENT WITH A LINEARLY INCREASING SPACING OF SUBSURFACE DRAINS,**  
Macdonald Coll., Ste. Anne de Bellevue (Quebec).  
Dept. of Agricultural Engineering.  
R. S. Broughton, and C. K-W. Tu.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 23 p, 9 fig, 3 tab, 10 ref. ASAE Paper 75-2526.

Descriptors: \*Drainage, \*Drainage effects, \*Drainage practices, \*Drainage systems, Crop response, Soil water, Soil water movement.

Subsurface drainage systems with diagonal drains between parallel drains were installed to give spacings varying continuously 6 to 60M on a minimum of land. Three drain depth replicates were used. Indications of the effects of depth and spacing of drains on water table depths, maize yields and soil trafficability were provided. (Skogerboe-Colorado State)

W76-13020

**EFFECT OF OPENINGS ON INFLOW INTO CORRUGATED DRAINS,**  
Ohio Agricultural Research and Development Center, Columbus.  
N. J. Bravo, and G. O. Schwab.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 13 p, 6 fig, 3 tab, 11 ref. ASAE Paper 75-2525.

Descriptors: \*Orifices, \*Orifice flow, \*Drainage, \*Drainage engineering, \*Drainage practices, Mathematical models, Model studies.  
Identifiers: Plastic drains.

The relative effectiveness of the openings in corrugated plastic drains, as influenced by the presence of soil within the corrugations and within the openings themselves was evaluated from the standpoint of water inflow for saturated conditions in a homogeneous, isotropic soil using a three-dimensional electric analog and mathematical models. (Skogerboe-Colorado State)

W76-13021

**PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEER DISTRICTS-SUMMARY OF EVALUATION AND RECOMMENDATIONS,**  
Ragan (James) Associates, Pacific Palisades, Calif.  
For primary bibliographic entry see Field 6E.

W76-13041

**PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEER DISTRICTS,**  
Ragan (James) Associates, Pacific Palisades, Calif.

For primary bibliographic entry see Field 6E.  
W76-13042

**FLOOD PLAIN INFORMATION, LOWER BUFFALO CREEK AND ITS TRIBUTARIES, NAHANTA AND BRANTLEY COUNTY, GEORGIA.**

Army Engineer District, Savannah, Ga.  
Prepared for Nahanta and Brantley County, Georgia, October 1972. 28 p, 53 plates, 11 fig, 5 tab.

Descriptors: \*Floods, \*Flood plains, \*Flood profiles, \*Flow duration, \*Streamflow Forecasting, \*Georgia, Storms, Hurricanes, Historic floods, Flood frequency, Flood stages, Flood peak, Flow characteristics, Warning systems.  
Identifiers: \*Buffalo Creek(Ga), Nahanta(GA), Brantley County(GA), Satilla River(GA), Standard Project Flood, Intermediate Regional Flood.

Buffalo Creek, a tributary of the Satilla River, with a drainage area of 160 square miles, subjects portions of the city of Nahanta and Brantley County to periodic flooding. With average slopes of 3.5 feet per mile, Buffalo Creek and its tributaries have flood plains which are largely undeveloped, currently heavily wooded and swampy. Several homes and businesses in the vicinity of Nahanta are subject to periodic flooding. Bridges, culverts, sand and soil deposits, and vegetation can obstruct floodflows. Seven large floods have occurred since 1929 as the result of thunderstorms, general rainstorms, and hurricanes or tropical storms. The most recent serious flooding occurred in 1969 when flood heights reached 38.7 feet above mean sea level and caused severe damage in the study area. The Intermediate Regional Flood and the Standard Project Flood would reach heights of 40.5 ft and 45.5 above MSI., respectively, and would have peak discharges of 6,440 and 16,100 cubic feet per second, respectively, on Buffalo Creek at Road B. The IRF would typically rise 10 feet in 12 hours and remain above bankfull 24 hours. Channel and overbank velocities would reach 6 and 14 feet per second, respectively. Considerable damage would be caused by an IRF. The SPF can be expected to rise 15 feet in 18 hours and remain above bankfull for 48 hours. Due to the wider extent, greater depths of flooding, higher velocity and longer duration of flooding, the Standard Project Flood would be disastrous. The National Weather Service issues flood warnings for the area. There are no existing city or county flood ordinances. (Henley, North Carolina.)

W76-13045

**FLOOD PLAIN INFORMATION: SCIOTO AND OLENTANGY RIVERS, OHIO, CHILLICOTHE AREA SUMMARY REPORT,**

Army Engineer District, Huntington, W. Va.  
Prepared by Dodson, Kinney and Lindblom, consulting engineers, Columbus, Ohio, for the Ohio Department of Natural Resources, October 1966. 19 p, 14 fig, 6 plates.

Descriptors: \*Floods, \*Flood profiles, \*Flood plains, \*Ohio, Flood data, Historic floods, Flood protection, Non-structural alternatives, Control structures.  
Identifiers: \*Scioto River(OH), \*Olentangy River(OH), \*Chillicothe(OH).

This summary of a main report covers the Scioto River, Paint Creek and North Fork flood plains in the Chillicothe area. The population of Ross County is expected to increase by only a third between 1960 and 1985 with anticipated growth in flood plain areas. The Chillicothe flood plain, the second largest flood damage center in the Scioto River

Basin, contains residential and commercial development which would be inundated by backwater flooding from Scioto River or from headwater flooding on Paint Creek and result in costly damages. The greatest flood in March 1913 caused \$2.5 million damages, and 18 lives were lost. A flood of this magnitude today would cause damages of \$30 million. Although the Delaware Reservoir (OH) has partly reduced flooding, a major flood on the Scioto River in January 1959, cresting at 7 feet below the 1913 flood and having half the flood flow, caused extensive damages. Severe damages to railroad structures and highways resulted from flooding in March 1963 and March 1964 on Paint Creek. Flood control proposals include 6 reservoirs, one of which is completed (the Delaware Reservoir in 1951), floodwalls, levees, and pumping stations. Existing flood plain management controls include Chillicothe's zoning regulations which could be used effectively to control flood plain developments. Guidelines for reducing future flood damages are described and include flood control works and flood plain management. (Salzman-North Carolina.)

W76-13046

**FLOOD PLAIN INFORMATION: VERDIGRIS, FALL AND ELK RIVERS, KANSAS.**  
Army Engineer District, Tulsa, Okla.

Prepared for the Kansas Water Resources Board, State of Kansas, Topeka, Kansas, January 1966. 39 p, 5 fig, 25 plates, 20 tab, 34 ref.

Descriptors: \*Floods, \*Flood forecasting, \*Flood profiles, Historic floods, Flood data, \*Flood plains, \*Kansas, Floodwater, Flooding, Flash flood, Streamflow forecasting, Maximum probable flood, Peak discharge, Levee, Dams, Reservoirs.  
Identifiers: \*Verdigris River(KS), \*Fall River(KS), \*Elk River(KS), Coffeyville(KS), Coyville(KS), Altona(KS), Frendonia(KS), Elk City(KS), Independence(KS), Lenapah(OK), Standard Project Flood.

This study covers the southeast corner of Kansas including several towns and villages plus extensive agricultural areas. Fall and Elk Rivers, with drainage areas of 884 and 702 square miles, respectively, are principal tributaries of the Verdigris River which drains 3,354 sq mi. They are streams of generally low slope which join the Arkansas River in Oklahoma. The comparatively flat valleys of these streams have been subject to frequent and extensive flooding. Excessive rainfall in months April through November is the chief cause of flooding. Flash floods sometimes occur. At least 6 major floods have occurred since 1885, the largest on the Verdigris River being the 1951 flood, and on the Elk River, the 1961 flood. Peak discharges recorded have been 130,000 cubic feet per second on the Verdigris River (1951), 49,000 cfs on the Fall River (1945), and 100,000 cfs on the Elk River (1961). No detailed record of damages is given in this report. It is estimated that the Fall River and Tornoto Reservoirs have prevented about \$13 million in damages through 1966. The Elk City and Big Hill Reservoirs were scheduled for completion in 1966 and 1970. It is estimated that with the four reservoirs in place bankfull capacity would be exceeded once in 2 years in Independence, KS, compared to more than twice a year without the reservoirs. On the Verdigris it is estimated that peak discharges of 64,000 cfs and 139,000 cfs would occur at the lower end of the study area during a 50 year flood and Standard Project Flood. Corresponding figures for the Fall River are 37,000 cfs and 104,000 cfs, and for the Elk River, 15,500 cfs and 29,400 cfs respectively. (Smith-North Carolina)

W76-13047

**THE IMPACT OF SUBURBANIZATION ON THE STREAM CHANNEL NETWORKS OF**

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**RALSTON CREEK AND SOUTH BRANCH, IOWA.**  
Iowa Univ., Iowa City. Dept. of Geography.  
For primary bibliographic entry see Field 4C.  
W76-13051

**ANNUAL REPORT FOR THE YEAR ENDING MARCH 31, 1975, SASKATCHEWAN DEPARTMENT OF THE ENVIRONMENT.**  
Saskatchewan Dept. of the Environment, Regina.  
For primary bibliographic entry see Field 6E.  
W76-13052

**FLOOD HAZARD ANALYSES: ROYAL RIVER AND CHANDLER BROOK, TOWN OF NORTH YARMOUTH, MAINE.**  
Soil Conservation Service, Washington, D.C.  
Prepared for the Town of North Yarmouth, Maine. June 1975. 46 p, 4 fig, 13 plates, 2 tab, 2 append.  
W76-13053

**Descriptors:** \*Floods, \*Flood profiles, \*Flood plains, \*Maine, Streamflow forecasting, Flood forecasting, Historic floods, Flood data, Peak discharge, Non-structural alternatives, Zoning, Control structures.  
**Identifiers:** \*Royal River(ME), Chandler Brook(ME), \*North Yarmouth(ME), 100-year flood, 500-year flood.

In the watershed, dairying is the principal enterprise. Little land is devoted to uses other than agriculture and woodland, though development pressure in North Yarmouth is increasing. Chandler Brook with a drainage area of 52 square miles is a tributary of Royal River which drains 142 sq mi. For the state of Maine as a whole, most floods occur in months March through April, and November, with the rest of the floods distributed throughout the remaining portion of the year. Streamgauge records, available for Yarmouth since 1949, indicate the largest flood occurred in September 1954 when Hurricane Edna passed through the state and 7.49 inches of rain were measured at Portland ME. The peak discharge was 7,960 cubic feet per second, approximately a 100 year frequency. In November 1966 a discharge of 5,040 cfs was recorded, an 8 year frequency. In 1954 damage was estimated at \$40,000 on highways and bridges throughout the watershed along with scattered commercial and residential properties. Results of surveys and calculations indicate peak discharges in a 100 year flood would be 8,000 cfs on Royal River, at confluence with Chandler Brook, and 3,950 cfs on Chandler Brook at the same location. In a 500 year flood, peak discharges of 9,600 cfs and 4,950 cfs are predicted for Royal River and Chandler Brook, respectively. Maine has adopted a Mandatory Zoning and Subdivision Control Law which requires municipal adoption of zoning and subdivision control ordinances for shoreline areas within 250 feet of the normal high water mark of any pond, river or salt water body. An appendix of this report contains a model zoning ordinance. (Smith-North Carolina)  
W76-13053

**COMPILING BATHYMETRY FOR FLOW SIMULATION MODELS.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-13064

**WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1975.**  
Geological Survey, Columbia, S.C.  
For primary bibliographic entry see Field 7C.  
W76-13066

**WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1975.**  
Geological Survey, Raleigh, N.C.  
For primary bibliographic entry see Field 7C.  
W76-13067

**WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1975.**  
Geological Survey, Huron, S. Dak.  
For primary bibliographic entry see Field 7C.  
W76-13073

**WATER RESOURCES DATA FOR IOWA, WATER YEAR 1975.**  
Geological Survey, Iowa City, Iowa.  
For primary bibliographic entry see Field 7C.  
W76-13074

**WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1975.**  
Geological Survey, Louisville, Ky.  
For primary bibliographic entry see Field 7C.  
W76-13075

**SURFACE WATER SUPPLY OF THE UNITED STATES, 1966-70: PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS—VOLUME 2. UPPER MISSISSIPPI RIVER BASIN ABOVE KEOKUK, IOWA.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-13076

**INDEX TO NATIONAL TOPOGRAPHIC MAPS: 1:250,000-SCALE SERIES.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-13077

**ESTIMATING PEAK DISCHARGES FROM SMALL DRAINAGES IN NEVADA ACCORDING TO BASIN AREAS WITHIN ELEVATION ZONES.**  
Geological Survey, Carson City, Nev.  
D. O. Moore.  
Nevada Highway Department, Carson City, Hydrologic Report No 3, 1976. 17 p, 4 fig, 4 tab, 2 ref.

**Descriptors:** \*Streamflow, \*Peak discharge, \*Estimating, \*Small watersheds, \*Nevada, Analytical techniques, Data collections, Hydrologic data, Elevation, Correlation analysis.  
**Identifiers:** Empirical relations.

Streamflow records were used to define empirical relations between the 10-year peak discharge and 1,000-foot elevation zones for drainage basins less than 150 square miles in Nevada. The data indicated there were two hydrologically homogeneous regions, one for northern Nevada and one for southern Nevada, with respect to the 10-year peak discharge and basin area within elevation zones. Therefore, an empirical relation was developed for each of the two regions. Peak discharges from ungaged drainages in each region can be estimated on the basis of the derived relation for the region in which the basin lies. The standard error of estimate is approximately 22 percent in the north and 35 percent in the south. The method is particularly useful in Nevada which is a semi-arid region of large relief where the relation between peak discharges and total drainage area is not well defined. The method does not appear to give reliable results when large parts of the drainage basin lie on the valley floor. A graphical relation between the 10-year and 25-year peak discharges was developed to estimate the 25-year discharge. (Woodard-USGS)  
W76-13080

**DIGITAL MODELS OF A GLACIAL OUTWASH AQUIFER IN THE PEARL-SALLIE LAKES AREA, WEST-CENTRAL MINNESOTA.**  
Geological Survey, St. Paul, Minn.  
For primary bibliographic entry see Field 2F.  
W76-13082

**A SIMPLIFIED SLOPE-AREA METHOD FOR ESTIMATING FLOOD DISCHARGES IN NATURAL CHANNELS.**  
Geological Survey, Reston, Va.  
H. C. Riggs.  
Journal of Research of the U S Geological Survey, Vol 4, No 3, p 285-291, May-June 1976. 4 fig, 3 tab, 7 ref.

**Descriptors:** \*Streamflow forecasting, \*Flood discharge, \*Channel flow, \*Equations, Drainage area, Slopes, Channel morphology, Flow resistance, Roughness(Hydraulic), Evaluation.

Discharge of a stream may be computed from the slope of the water surface, the cross-sectional area, and an estimate of channel roughness. This, the slope-area method, is widely used to compute flood peak discharges from high-water marks. Reliability of a computed discharge depends largely on the roughness coefficient, which must be estimated. This paper shows that results of comparable accuracy can be obtained from area and slope alone in natural channels; a roughness coefficient is not needed because roughness and slope are related. The estimating equation and suggestions for application of the simplified method are included. (Woodard-USGS)  
W76-13083

**TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW FREQUENCY CHARACTERISTICS OF STREAMS IN THE SUSQUEHANNA RIVER BASIN.**  
Geological Survey, Harrisburg, Pa.  
J. T. Armbruster.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 455, \$4.50 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 76-51, June 1976. 51 p, 12 fig, 1 plate, 15 tab, 14 ref.

**Descriptors:** \*Low flow, Streamflow, \*Frequency analysis, \*Regression analysis, \*Regional analysis, River basins, Pennsylvania, New York, Maryland, Hydrology, Flow rates, Flow characteristics.  
**Identifiers:** \*Susquehanna River basin.

Procedures are presented for estimating low-flow frequency characteristics for streams in the Susquehanna River basin. The techniques can be used at ungaged sites as well as sites where insufficient data are available to make a reliable estimate. In this report streams are classified as major or minor streams. Major streams are those whose drainage area is generally larger than 2,000 sq mi and in one of the following river reaches: the Chemung River between its mouth and the mouth of Tioga River; the Susquehanna River from Marietta, Pa., to the mouth of the Chenango River; the Juniata River from its mouth to the mouth of Raystown Branch Juniata River; and the West Branch Susquehanna River from its mouth to Renova, Pa. Minor streams are all streams in the basin with drainage areas less than 2,000 sq mi and not on one of the major streams. Multiple-regression techniques have been used to develop relations for estimating the 1-, 3-, 7-, 30-, and 183-day duration low flows at recurrence intervals of 10, 20, 50 and 100 years for the annual series data and the 1-, 3-, 7-, and 30-day duration low flows, at the same recurrence intervals, for six individual months, May through October, inclusive. (Woodard-USGS)  
W76-13086

**THE DEVELOPMENT CRITERIA OF THE PRELIMINARY COASTAL PLAN,**  
University of Southern California, Los Angeles. School of Public Administration.  
For primary bibliographic entry see Field 2L.  
W76-13092



## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Groundwater Management—Group 4B

#### DROUGHT RESISTANCE OF BLUE GRAMA AS AFFECTED BY ATRAZINE AND N. FERTILIZER.

Agricultural Research Service, Fort Collins, Colo.  
For primary bibliographic entry see Field 21.  
W76-13122

#### DYNAMICS OF THE ROOT SYSTEM OF BLUE GRAMA.

ALVAR Aluminio Argentina, Cangallo. Area Investigation y Desarrollo.  
For primary bibliographic entry see Field 21.  
W76-13123

#### PLANT SURVIVAL IN THE ARID SOUTHWEST 30 YEARS AFTER SEEDING.

Arizona State Univ., Tempe.  
B. I. Judd, and L. W. Judd.  
Journal of Range Management, Vol. 29, No. 3, p 248-251, May 1976. 2 fig, 1 tab, 5 ref.

Descriptors: \*Range management, \*Arid lands, \*Arizona, \*Southwestern U.S., \*Desert plants, Range grasses, Shrubs, Vegetation, Soil-water-plant relationships, Vegetation establishment, Wheat grasses.  
Identifiers: \*Tonto National Forest (Arizona).

Of 48 plant species seeded in 1945 in the Tonto National Forest, Arizona, 13 survived for at least 20 years and 7 for 30 years. Original planting included 41 species of grass and grass-like plants and 7 of shrubs. Planting sites were in semidesert shrub or grassland, chaparral, or pinyon-juniper areas, sites picked as representative of forest acreage and low rainfall situations. Plants which survived for at least 20 years are recommended for restoring depleted rangelands in the Southwest, the species used depending on the site. Two wheatgrasses, Turkestan bluestem, three lovegrasses, and rough menodora did well where planted, especially with site preparation and mulching. Those which survived a full 30 years were crested wheatgrass and weeping lovegrass in the grassland, and Boer and Lehmann lovegrasses, blue panicgrass, sand dropseed and menodora in the chaparral. No species survived in semidesert shrub or pinyon-juniper sites. Blue panicgrass and white tridens disappeared some seasons but made periodic returns, possibly due to moisture relations. (Jahns-Arizona)  
W76-13128

#### SEMIARID RANGELAND TREATMENT AND SURFACE RUNOFF.

Agricultural Research Service, Las Cruces, N. Mex. Jornada Experimental Range.  
J. M. Tromble.  
Journal of Range Management, Vol. 29, No. 3, p 251-255, May 1976. 7 fig, 2 tab, 15 ref.

Descriptors: \*Range management, \*Soil conservation, \*Arid lands, \*Pitting (Corrosion), \*Surface runoff, \*Arizona, Soil surfaces, Vegetation effects, Surface sealing, Storage, Water yield, Rainfall-runoff relationships.  
Identifiers: Walnut Gulch Experimental Watershed (Ariz.).

Effects are reported of pitting and rootplowing on surface runoff at the Walnut Gulch Experimental Watershed, a desert shrub range in southeastern Arizona, and the time-dependent changes in soil surface characteristics caused by such practices. Rock and gravel were negatively correlated with surface runoff, but when combined (erosion pavement) caused a significant runoff reduction. Exposed soil caused runoff increases, while crown cover caused decreases. Runoff was significantly correlated with percent bare soil at the 1% level; rock and gravel were negatively correlated with runoff at the 1 to 5% levels, respectively. Litter produced no significant runoff reduction. The surface roughness of rootplowed and pitted plots provided detention storage for average-sized storms,

and conservation treatments reduced runoff compared with control conditions. Rootplow treatment had the lowest yield for 1970 and 1971, but overgrazing increased runoff in 1972. Decreased vegetative cover due to heavy grazing or after rangeland conversion caused decreased rainfall interception and contributed to soil surface sealing. (Jahns-Arizona)  
W76-13130

#### RANGE FERTILIZATION IN THE NORTHERN GREAT PLAINS.

Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center.  
J. R. Wight.  
Journal of Range Management, Vol. 29, No. 3, p 180-185, May 1976. 2 fig, 30 ref.

Descriptors: \*Range management, \*Fertilization, \*Great Plains, \*Nitrogen, \*Crop production, Forages, Grazing, Water utilization, Soil-water-plant relationships, Forage palatability.  
Identifiers: \*Water-use efficiency.

Summaries are presented of forage and animal responses to range fertilization in the northern Great Plains where nutrient deficiency, especially of nitrogen, is a major growth-limiting factor. With proper management, applications of 30 to 50 lb N/acre/year can increase forage production 50 to 100%, with N-use efficiency of about 20 lb dry matter/lb N applied, or in grazing situations about 1 lb/lb N. Higher rates will produce more beef but less efficiently. Range fertilization can also improve water-use efficiency and forage quality and palatability. With applications of 50 lb N/acre/year or less, species composition changes gradually and can be controlled by application timing and by season and grazing intensity. Dramatic changes in species composition usually occur when applications exceed 150 lb N/acre. Because of the close relationship between water-use efficiency and forage yields, responses in both are similar. Fertilization can also increase the amount of precipitation available for plant use because the stimulated root system extracts more water from the profile. (Jahns-Arizona)  
W76-13131

#### THE USE OF LINEAR PROGRAMMING TECHNIQUES FOR ESTIMATING THE BENEFITS FROM INCREASED ACCURACY OF WATER SUPPLY SYSTEMS.

Battelle Memorial Inst., Columbus, Ohio.  
For primary bibliographic entry see Field 6A.  
W76-13169

#### INTERDISCIPLINARY APPLICATIONS AND INTERPRETATION OF EREP DATA WITHIN THE SUSQUEHANNA RIVER BASIN.

Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.  
For primary bibliographic entry see Field 7B.  
W76-13188

### 4B. Groundwater Management

#### FEASIBILITY OF MICROBIAL DECOMPOSITION OF ORGANIC WASTES UNDER CONDITIONS IN DEEP WELLS.

Oklahoma State Univ., Stillwater. Dept. of Microbiology.  
For primary bibliographic entry see Field 5D.  
W76-12688

#### GROUND-WATER BASIC DATA FOR DUNN COUNTY, NORTH DAKOTA.

Geological Survey, Bismarck, N. Dak.  
For primary bibliographic entry see Field 7C.  
W76-12786

#### ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1974 TO SPRING 1975.

Geological Survey, Tucson, Ariz.  
For primary bibliographic entry see Field 7C.  
W76-12792

#### MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED BY THE U. S. ENVIRONMENTAL DATA SERVICE, AND BY THE U. S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.

Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12794

#### WATER FOR INDUSTRIAL AND AGRICULTURAL DEVELOPMENT IN COAHOMA, DE SOTO, PANOLA, QUITMAN, TATE, AND TUNICA COUNTIES, MISSISSIPPI.

Geological Survey, Jackson, Miss.  
For primary bibliographic entry see Field 3E.  
W76-12798

#### FLUCTUATIONS OF GROUND-WATER LEVELS IN LEE COUNTY, FLORIDA, IN 1974.

Geological Survey, Tallahassee, Fla.  
T. M. Missimer, and T. H. O'Donnell.  
Open-file report FL-75008, 1976. 75 p, 40 fig, 7 tab, 4 ref.

Descriptors: \*Observation wells, \*Groundwater, \*Water level fluctuations, Pumping, Groundwater recharge, Aquifers, Water table, Hydrologic data, \*Florida.  
Identifiers: Lee County (Fla.).

Drought and high-water conditions occurred in Lee County, Fla., during the 1974 water year. In response to increased pumping during the dry season, water levels in most observation wells tapping the water-table, sandstone, upper Hawthorn, and lower Hawthorn aquifers dipped to record-low levels. During the succeeding wet season, levels in most of the observation wells recovered to nearly normal levels. In some localities, water levels in wells tapping the sandstone aquifer have been declining over the years. Heavy pumping in west-central Lee County has resulted in a continuing decline of water levels in the upper Hawthorn aquifer. (Woodard-USGS)  
W76-12801

#### A HYPOTHESIS OF ION FILTRATION IN A POTABLE-WATER AQUIFER SYSTEM.

Geological Survey, Austin, Tex.  
W. W. Wood.  
Ground Water, Vol. 14, No. 4, p 233-244, July-August 1976. 9 fig, 4 tab, 22 ref.

Descriptors: \*Filtration, \*Ions, \*Ion transport, \*Potable water, \*Aquifer systems, Chemical reactions, Water chemistry, Geochemistry, Reverse osmosis, Sampling, Chemical analysis, Evaluation.  
Identifiers: \*Grand River basin (Mich.), \*Saginaw aquifer system.

Chemical analyses of major dissolved constituents in approximately 300 samples of ground water and 60 samples of stream water indicate that the process of ion filtration may control the distribution of some major ionic species in the water of the Saginaw aquifer system. This system, which is in the upper Grand River basin of the central part of the southern peninsula of Michigan, consists of sandstone, shale, coal, and limestone of the Saginaw Formation of Pennsylvanian age and overlying glacially deposited sand and clay of late Wisconsin age. The Saginaw Formation is recharged through the glacially deposited material; however, the concentrations of iron, calcium,

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sulfate, and chloride are greater in water in the glacial deposits than in water in the underlying Saginaw Formation. It is hypothesized that shale beds in the Saginaw Formation act as ionic filters, allowing water with a lower dissolved-solids concentration to move through the shale to the sandstone aquifer. A concentration of ions greater than input value forms above the shale beds. Gravity provides the energy necessary to filter the water in a process of reverse osmosis. The similarity of this hydrogeologic system to other systems suggests that ion filtration may occur in many potable-water aquifers. (Woodard-USGS)  
W76-12803

**A SUMMARY OF THE GROUND-WATER HYDROLOGY OF THE AREA BETWEEN THE LAS VEGAS VALLEY AND THE AMARGOSA DESERT, NEVADA, WITH SPECIAL REFERENCE TO THE EFFECTS OF POSSIBLE NEW WITHDRAWALS OF GROUND WATER,**  
Geological Survey, Reston, Va.  
I. J. Winograd.

Available from the National Technical Information Service, Springfield, VA 22161 as TEI 840, \$5.00 in paper copy, \$3.00 in microfiche. Report TEI-840, September 1963. 79 p, 2 fig, 56 ref, append.

Descriptors: \*Groundwater resources, \*Available water, \*Water supply, \*Hydrogeology, \*Surveys, City planning, \*Nevada, Data collections, Aquifer characteristics, Water yield, pumping, Water quality, Hydrologic budget.  
Identifiers: \*Nevada test site(Nev), Las Vegas Valley(Nev), Amargosa Desert(Nev).

Three general areas in the vicinity of Mercury, Nevada, are being considered by the Atomic Energy Commission for development of a town to facilitate operations at the Nevada Test Site. The hydrologic environment in which the townsite water supplies might be developed and the effects of pumping groundwater at each of several potential townsites upon other water supplies is summarized. Two extensive ground-water basins are involved in the townsite water-supply development. The Ash Meadows ground-water basin consists of several hydraulically connected valleys including Three Lakes and Indian Spring Valleys, Frenchman, Yucca, and Jackass Flats, the Amargosa Desert and Pahrump Valley. The Las Vegas ground-water basin consists primarily of the Las Vegas Valley. (Woodard-USGS)  
W76-12807

**HYDROLOGY OF LIMESTONE TERRANES, PROGRESS OF KNOWLEDGE ABOUT HYDROLOGY OF CARBONATE TERRANES,**  
Geological Survey of Alabama, University.  
For primary bibliographic entry see Field 2F.  
W76-12813

**PUBLIC GROUNDWATER SUPPLIES IN LAKE COUNTY,**  
Illinois State Water Survey, Urbana.  
D. M. Woller, and J. P. Gibb.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 256, \$5.00 in paper copy, \$3.00 in microfiche. ISWS Bulletin 60-20, 1976. 91 p, 2 fig.

Descriptors: \*Water supply, \*Illinois, \*Groundwater resources, Unconsolidated aquifers, Well data, Gravels, Sand aquifers, Bedrock, Sandstones, Dolomite, Groundwater availability, Groundwater, Hydrology, Hydrogeology, Water sources, Water quality, Water wells, Municipal water, Water yield, Water properties, Hardness(Water), Chemical properties, Deep wells, Shallow wells, Geology, Aquifers.  
Identifiers: \*Lake County(Ill), Dissolved minerals, Water bearing formations.

All available information on production wells used for public water supplies in Lake County, Illinois, was presented. The definition of public water supply as contained in the Environmental Protection Act of 1970 was used to determine those water systems and wells to be included. The report included separate descriptions for 57 public water supply systems furnishing water to 23 municipalities, 32 subdivisions, 2 state parks, and 1 treatment plant in Lake County. These were preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for public use. Individual production wells for each supply were described in the order of their construction. The description for each well included the aquifer or aquifers tapped, date drilled, depth, driller, legal location, elevation in feet above mean sea level, log, construction features, yield, pumping equipment, and chemical analyses. (Humphreys-ISWS)  
W76-12824

**ONSET OF THERMOHALINE CONVECTION IN A CAVERNOUS AQUIFER,**  
Florida Univ., Gainesville. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W76-12835

**ANALYSIS OF AQUIFER-AQUITARD FLOW,**  
Birmingham Univ. (England). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W76-12836

**SOLID WASTES AND WATER QUALITY. (LITERATURE REVIEW),**  
Environmental Protection Agency, Washington, D. C. Wastewater Research Div.  
For primary bibliographic entry see Field 5E.  
W76-12933

**GROUND-WATER QUALITY VARIATION IN PHELPS COUNTY, MISSOURI,**  
Forest Service (USDA), Rolla, Mo. Clark National Forest.  
For primary bibliographic entry see Field 5B.  
W76-12991

**GROUNDWATER GEOPHYSICS IN SOUTH AFRICA,**  
Wellfield Services, Johannesburg (South Africa).  
C. D. Mackie.  
Journal of the Groundwater Association of South and South West Africa, Vol. 1, No. 3, p 7, 9-10, December, 1975. 4 fig.

Descriptors: \*Geophysics, \*Electrical studies, \*Gravity studies, Africa, \*Magnetic studies, \*Seismic studies, Subsurface mapping, \*Groundwater.  
Identifiers: \*Geophysical methods, South Africa.

The use of ground-water geophysical methods in prospecting for groundwater sources is comparatively new to South Africa. A great potential for its use exists not only in remote and arid areas, but also in the more densely populated areas where the need exists for increased supplies of potable water supplies. Several of the more basic methods now in use in South Africa are: gravity surveys, magnetic surveys, electrical resistivity surveys and seismic survey methods. These geophysical methods are suited predominantly to flat or undulating terrain where the overburden is relatively thin. The methods used in a specific situation are dictated by the physical properties of the rocks. Since some methods may be more economical than others the choice may be swayed in that respect. It is in the selection and application of the many different techniques that the role of the hydrogeophysicist becomes highly important. (Heiss-NWWA)  
W76-13027

**WATER REQUIRED TO DEVELOP GEOTHERMAL ENERGY,**  
Texas University at Austin. Geothermal Studies.  
For primary bibliographic entry see Field 3E.  
W76-13030

**GROUND WATER MOVEMENT,**  
National Water Well Association, Worthington, Ohio.  
T. E. Gass.  
Water Well Journal, Vol. 30, No. 9, September, 1976. p 26-27, 1 fig.

Descriptors: \*Groundwater movement, \*Water table, \*Water yield, \*Saturation, \*Permeability, \*Aquifers, Evaporation, Transpiration, Transmissivity, Fractures, Fissures, Igneous rock, Carbonate rock, Sediments, Precipitation(Atmospheric).  
Identifiers: Unconsolidated materials(Geologic), Solution cavities.

Nearly all ground water originates as precipitation. As rain falls on an area, some will penetrate into the ground. Of this water, some will eventually return to the atmosphere through evapotranspiration. The remainder will infiltrate the ground whether it consists of unconsolidated material, fractured rock, or solution cavities. Ground water usually enters the aquifer within a radius of 10 miles from its point of withdrawal, exceptions are rare. Ground water is not usually found in flowing veins or underground rivers, but travels slowly between pores and in fractures of rocks. Under non-artesian conditions, water moves downward through the overlying rock. The larger, more rounded, and better sorted the grain size in a rock, the greater the permeability will be. As compaction increases with depth, the ability to transmit water is retarded. When the overlying beds are of very low permeability, more of the water must move horizontally from adjacent areas. Where interconnected pore spaces in rocks are too small to permit significant water movement, fractures will provide a route for ground water movement between the surface and the water table. The water table is the upper surface of the water saturated underground rock strata which approximately parallels the overlying topography, and controls the direction of ground water flow. Due to the fact that subsurface materials are not uniform and fractures tend to occur in zones, water yield will vary from one locality to another. (Grober-NWWA)  
W76-13031

**ENGINEERED IRRIGATION WELLS.**  
The Cross Section, Vol. 23, No. 8, p 1,2,3,4, August, 1976. 2 fig.

Descriptors: \*Irrigation wells, \*Water wells, \*Irrigation water, \*Well screens, Pumping, Gravels, Aquifers, Aquifer characteristics.  
Identifiers: \*Engineered water wells, \*Gravel pack design, \*Screen selection, \*Well efficiency, Pumping tests, Well development, Drilling costs, Sand pumping, Aquifer depletion, Energy costs, Pump maintenance, Ogallala formation, High plains region.

The 'engineered well' in the past, has not been accepted for the installation of irrigation and other types of wells systems in the high plains area. The word engineering tends to connote something complex and is more often considered an expensive operation. Decreasing well yields by aquifer depletion, increasing energy and well hardware costs, and peak crop water demand; however, are making the engineered well more palatable to the irrigation farmer. Increased production, dependability, higher efficiency, and lower energy and well maintenance costs make the engineered well the common sense alternative to high plains irrigators. Engineered wells are designed to fit the aquifer at the specific well site. Gravel pack and screen selection are the prime factors in well design for the high plains irrigation well. Proper developing



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techniques and prolonged pumping test complete the necessary engineered well installation process. The engineered irrigation well will cost approximately twice the ordinary irrigation well, but it will also provide a useful life and sustained performance for many times longer than the half price well. (Heiss-NWWA)  
W76-13033

**EFFICIENT AQUIFER DEVELOPMENT IS NECESSARY TO EXPLOIT FULL YIELD POTENTIAL.**  
Wellfield Services, Johannesburg (South Africa).  
Div. of Drilling Technical Services Ltd.  
For primary bibliographic entry see Field 8B.  
W76-13035

**WELL CUTTINGS ANALYSIS IN GROUND-WATER RESOURCES EVALUATION.**  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
For primary bibliographic entry see Field 8G.  
W76-13036

**AVAILABILITY OF GROUND WATER IN THE MIDDLE CONNECTICUT RIVER BASIN, WEST-CENTRAL NEW HAMPSHIRE.**  
Geological Survey, Concord, N. H.  
For primary bibliographic entry see Field 7C.  
W76-13062

**WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1975.**  
Geological Survey, Columbia, S. C.  
For primary bibliographic entry see Field 7C.  
W76-13066

**WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1975.**  
Geological Survey, Raleigh, N. C.  
For primary bibliographic entry see Field 7C.  
W76-13067

**TWO-DIMENSIONAL STEADY-STATE DISPERSION IN A SATURATED POROUS MEDIUM.**  
Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 2F.  
W76-13071

**GEOLOGY AND GROUND-WATER RESOURCES OF UNION COUNTY, NEW JERSEY.**  
Geological Survey, Trenton, N. J.  
B. Nemickas.  
Water-Resources Investigations 76-73, June 1976.  
103 p, 14 fig, 1 plate, 6 tab, 26 ref.

Descriptors: \*Groundwater resources, \*Water wells, \*Water yield, \*Water quality, \*Hydrogeology, Aquifer characteristics, Withdrawal, Water supply, Groundwater recharge, Specific capacity, Water level fluctuations, Well data, Chemical analysis, Geology.  
Identifiers: \*Union County(NJ).

Ground water in Union County, N. J., occurs in the voids of unconsolidated stratified drift deposits of Pleistocene age and in the joints and fractures of the Brunswick Formation and Watchung Basalt of Late Triassic age. Wells (6 inches or greater in diameter) in the stratified drift deposits yield from 180 to 690 gallons per minute (gpm). Wells (6 inches or greater in diameter) in the Brunswick Formation yield from 12 to 870 gpm. Withdrawals of ground water from all aquifers in Union County for public supply are estimated to average about 16.0 million gallons per day (mgd) in 1968. The greatest quantity of ground water is withdrawn from the Brunswick Formation—about 11.6 mgd for public supply in 1968. The stratified drift aquifers yield substantial quantities

of water—about 4.4 mgd in 1968—but the deposits are of limited extent. The Watchung Basalt is of minor importance as an aquifer in Union County. The quality of ground water from the stratified drift deposits is generally acceptable for most uses. Hardness ranges from 110 to 210 mg/liter. The pH ranges from 6.4 to 8.5. The quality of ground water from the Brunswick Formation is acceptable throughout the country for most uses. Hardness ranges from 71 to 1193 mg/liter. The pH ranges from 6.3 to 8.5. (Woodard-USGS)  
W76-13072

**WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1975.**  
Geological Survey, Huron, S. Dak.  
For primary bibliographic entry see Field 7C.  
W76-13073

**WATER RESOURCES DATA FOR IOWA, WATER YEAR 1975.**  
Geological Survey, Iowa City, Iowa.  
For primary bibliographic entry see Field 7C.  
W76-13074

**WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1975.**  
Geological Survey, Louisville, Ky.  
For primary bibliographic entry see Field 7C.  
W76-13075

**GEOHYDROLOGY OF THE OKLAHOMA PANHANDLE, BEAVER, CIMARRON, AND TEXAS COUNTIES.**  
Geological Survey, Oklahoma City, Okla.  
D. L. Hart, Jr., G. L. Hoffman, and R. L. Goemaat.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-254 028, \$6.00 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 25-75, April 1976. 62 p, 15 fig, 10 plates, 6 tab, 38 ref.

Descriptors: \*Hydrogeology, \*Aquifer characteristics, \*Irrigation, \*Water quality, \*Oklahoma, Water utilization, Groundwater resources, Withdrawal, Water yield, Water levels, Groundwater recharge, Groundwater availability, Chemical analysis, Maps.  
Identifiers: \*Oklahoma Panhandle.

The Ogallala aquifer is the principal source of ground water in the Oklahoma Panhandle. Based on an estimated average storage coefficient of 0.1, the quantity of water stored in the Ogallala aquifer was computed at approximately 50 million acre-feet. Local overdevelopment of this water resource has resulted in water-level declines of more than 40 feet from 1966 to 1972. The amount of ground water in storage has been reduced about 2 percent. Aquifer tests indicate that transmissivity ranges from 500 to 11,800 feet squared per day, the storage coefficient ranges from 0.002 to 0.11, and hydraulic conductivity ranges from 2.1 to 55 feet per day. Other aquifers that locally yield sufficient water for irrigation are the Dakota and Cheyenne Sandstone. Water levels in these aquifers have not shown the pronounced declines that have occurred in the Ogallala aquifer. Water in the Ogallala aquifer, Dakota Sandstone, and Cheyenne Sandstone Member generally has a dissolved-solids concentrations of less than 500 mg/liter. The dissolved-solids concentration in water from the Permian red beds generally exceeds 500 mg/liter and locally exceeds 2,000 mg/liter. (Woodard-USGS)  
W76-13081

**DIGITAL MODELS OF A GLACIAL OUTWASH AQUIFER IN THE PEARL-SALLIE LAKES AREA, WEST-CENTRAL MINNESOTA.**  
Geological Survey, St. Paul, Minn.  
For primary bibliographic entry see Field 2F.  
W76-13082

**FACTORS AFFECTING DECLINING WATER LEVELS IN A SEWERED AREA OF NASSAU COUNTY, NEW YORK.**  
Geological Survey, Albany, N.Y.  
For primary bibliographic entry see Field 5B.  
W76-13084

**FINITE-DIFFERENCE MODEL FOR AQUIFER SIMULATION IN TWO DIMENSIONS WITH RESULTS OF NUMERICAL EXPERIMENTS.**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 2F.  
W76-13085

**MORE WATER: ONE CITY'S PLAN.**  
Henningson, Durham and Richardson, Inc., Henderson, Tex.  
For primary bibliographic entry see Field 6D.  
W76-13097

**VERTICAL TEMPERATURE AND CHEMICAL GRADIENTS IN GROUNDWATER IN THE TUCSON BASIN, ARIZONA.**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
S. G. Mburu.  
Master of Science Thesis, 1975. 93 p, 24 fig, 4 tab, 42 ref, 3 append.

Descriptors: \*Groundwater, \*Water temperature, \*Water chemistry, \*Water analysis, \*Water wells, Aquifers, Water sampling, Electrical conductance, Hydrogen ion concentration, Well data, Drilling, Testing procedures, \*Arizona.  
Identifiers: \*Tucson Basin(Ariz), Well bores.

Vertical temperature and chemical gradients studied in the groundwater of Tucson Basin indicated that temperature gradients can be used as an index of vertical mixing in well bores and thus as a guide for interpreting point samples for chemical analysis. A glass-probe thermometer was used for measuring water temperature variations at different well bore depths. Techniques for plotting and analysis are described, and results given and graphed. Compared profiles of temperature, electrical conductivity, and bicarbonate and chloride contents indicated agreement with the assumed hypotheses of vertical flow and/or mixing in well bores for half of the sampled wells. Chemical gradient anomalies noted were partly due to incomplete chemical analysis; another possible cause is a general uniform chemical composition of aquifer water which does not change significantly with depth. Water chemistry was relatively uniform and had little variation with depth; pH studies revealed that water in most wells was in or close to equilibrium with respect to calcite. The water is mainly of sodium or calcium bicarbonate type in irrigation water class C2-S1. Applications of this water sampling technique are suggested. (Jahns-Arizona)  
W76-13129

**GEOHERMAL ENERGY SYSTEM HEAT EXCHANGER AND CONTROL APPARATUS.**  
Sperry Rand Corp. New York. (Assignee).  
K. E. Nichols.  
U. S. Patent No. 3,961,866, 5 p, 5 fig, 9 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 690-691, June 8, 1976.

Descriptors: \*Patents, \*Geothermal studies, \*Temperature, Thermal properties, Energy, \*Energy transfer, \*Heat exchangers, Injection, Injection wells, Steam turbines, Electrical power plants.

A geothermal energy transfer and utilization system extracts thermal energy stored in hot solute-bearing well water to generate super-heated steam from an injected flow of clean water; the super-heated steam is then used for driving a turbine-driven pump at the well bottom for pumping

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4B—Groundwater Management

the hot solute-bearing water at high pressure and always in liquid state to the earth's surface, where it is used by transfer of its heat content to a closed-loop vapor generator-turbine-alternator combination for the generation of electrical or other power. Cooled, clean water is regenerated by the surface-located system for re-injection into the deep well and the residual concentrated solute-bearing water is pumped back into the earth. Heat exchanger apparatus is located adjacent the turbine-driven pump for permitting steam exhausted by the turbine to cool that part of the re-injected water used as a hydraulic bearing lubricant. (Sinha-OEIS) W76-13139

### 4C. Effects On Water Of Man's Non-Water Activities

**MOVEMENTS AND GROWTH OF ARCTIC GRAYLING (THYMALLUS ARCTICUS) AND JUVENILE ARCTIC CHAR (SALVELINUS ALPINUS) IN A SMALL ARCTIC STREAM, ALASKA.** Aquatic Environments Ltd., Crossfield (Alberta). For primary bibliographic entry see Field 5C. W76-12756

### SELECTED EFFECTS OF SUBURBAN DEVELOPMENT ON RUNOFF IN SOUTH-COASTAL, CALIFORNIA.

Geological Survey, Menlo Park, Calif. T. J. Durbin.

In: Proceedings of National Symposium on Urban Hydrology and Sediment Control, held at University of Kentucky, Lexington, Kentucky, July 28-31, 1975: American Society of Civil Engineers, p 209-217, 1975. 8 fig, 7 tab, 9 ref.

Descriptors: \*Urban hydrology, \*Urbanization, \*Urban runoff, \*Model studies, \*Flow characteristics, Watersheds(Basins), Streamflow, Flow rates, Peak discharge, Storm runoff, Evaluation, \*California.

Identifiers: \*South-coastal California.

The Stanford Watershed Model was used to simulate the effects of suburban development on the runoff from five drainage basins in the south-coastal area of California, a region with a semiarid climate and an average annual precipitation of 15 inches. The drainage basins ranged in size from 3.72 to 83.4 square miles. Using the model, synthetic records of runoff for each basin were generated to represent various degrees of suburban development. Examination of the synthetic records indicated that suburban development has the following effects on runoff: (1) Average annual runoff from a drainage basin with an effective impervious area of 10 percent of the drainage area is approximately 2 inches. The average annual runoff from a fully developed basin with an effective impervious area of 30 percent is approximately 4 inches. (2) Suburban development can increase the magnitude of peak discharge with a recurrence interval of 2 years by a factor of three to six. (3) Peak discharges that have recurrence intervals greater than a limiting value ranging from 50 to 200 years or more are little affected by suburban development. (Woodard-USGS) W76-12810

### URBAN HYDROLOGY FOR SMALL WATERSHEDS.

Soil Conservation Service, Washington, D. C. Engineering Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 531, \$5.00 in paper copy, \$3.00 in microfiche. Report SCS/ENG/TR-55, Technical release No. 55, Final report. January, 1975. 40 p, 12 tab, 17 fig, 5 append.

Descriptors: \*Urban runoff, \*Urban hydrology, \*Runoff, \*Floods, \*Peak discharges, Surface runoff, \*Urbanization, Vegetation, \*Land use, Detention, \*Retention, Graphical method, Water velocity, Watershed management, Reservoirs, Cisterns, Pondage, Infiltration, Storage. Identifiers: Tabular method, SCS-TR-20 method, \*Soil-cover-complex method.

Urbanized watersheds are covered by impervious structures such as roads, sidewalks, parking lots and houses. Transition from rural to urban land uses increases runoff volume and peak discharges. "The amount of runoff from a storm depends on detention, infiltration, evapotranspiration, etc. and is related to soil type, type of vegetation, and amount of impervious cover." With modifications, a soil-cover-complex method can be used to estimate runoff in urban areas. Peak rate of runoff is determined by 3 watershed parameters related to the velocity water flows from point of impact to watershed outlet: time of concentration, travel time and watershed lag. Decreasing peak discharges and dangers of flood require control methods dealing with storage availability, outflow rate and inflow rate. Advantages and disadvantages of measures for reducing or delaying runoff are given for cisterns, rooftop gardens, surface pond storage, ponding on roof, roof roughness, porous pavement, grass channels, vegetated strips, reservoir or detention basin, converted septic tank for storage, ground water recharge, high-delay grass and routing flow over lawns. Tabular, graphic and the SCS-TR-20 methods of determining peak flows are discussed. (Gentry-North Carolina) W76-13044

### THE IMPACT OF SUBURBANIZATION ON THE STREAM CHANNEL NETWORKS OF RALSTON CREEK AND SOUTH BRANCH, IOWA.

Iowa Univ., Iowa City. Dept. of Geography. W. L. Graf.

Institute of Urban and Regional Research, University of Iowa, Iowa City, Technical Report No. 62, October 1975. 37 p, 8 fig, 3 tab, 16 ref, append.

Descriptors: \*Drainage systems, \*Urbanization, Streams, \*Channels, \*Peak discharge, Urban drainage, Water control, Water management(Applied), Channeling, Erosion, Deposition, Stream flow, \*Iowa. Identifiers: Bifurcation ratio, Arrangement index, Energyscape.

Drainage channels change their cross-sectional shape as a result of increased runoff from impervious suburban surfaces. Stream discharge represents energy responsible for environmental change or continuity. Channel networks spatially control hydrological activity, and thus also control distribution of energy, called the energyscape. This study is concerned with how the effect of artificial channels created during suburbanization alter the character of stream networks and influence flooding, erosion and deposition problems. Twenty-three variables are used to describe the effects suburbanization has on stream networks and stream flows. Principal variables are the number and length of exterior and interior links and channels, drainage area, drainage density, bifurcation ratio and arrangement index. It was concluded that network changes have contributed to flooding and consequences on fluvial landforms are expected. Future research will attempt to determine the relationship between network parameters and hydrologic parameters, and link network characteristics to flood characteristics by regression models. (Gentry-North Carolina) W76-13051

### FACTORS AFFECTING DECLINING WATER LEVELS IN A SEWERED AREA OF NASSAU COUNTY, NEW YORK.

Geological Survey, Albany, N.Y. For primary bibliographic entry see Field 5B.

W76-13084

### 4D. Watershed Protection

### THE SIMPLIFIED INTEGRAL MATHEMATICAL MODEL ON A SMALL LOW-LAND CATCHMENT.

Technical Univ. of Warsaw (Poland). Inst. of Environmental Engineering. For primary bibliographic entry see Field 2A. W76-12831

### EFFICIENCY OF NITROGEN, CARBON, AND PHOSPHORUS RETENTION BY SMALL AGRICULTURAL RESERVOIRS.

Agricultural Research Service, Oxford, Miss. Sedimentation Lab. A. C. Gill, J. R. McHenry, and J. C. Ritchie. Journal of Environmental Quality, Vol. 5, No. 3, p 310-315, July-September 1976. 3 tab, 29 ref.

Descriptors: \*Nitrogen compounds, \*Phosphorus compounds, \*Soil erosion, \*Reservoir silting, Carbon, \*Mississippi, Nitrogen, Analytical techniques, Nitrates, Fertilizers, Nutrient removal, Phosphorus, Phosphates, Sediments, Sedimentation, Reservoirs, Erosion, Impoundments, Soils, Watersheds(Basins), Trap efficiency. Identifiers: \*Nitrogen retention, \*Carbon retention, \*Phosphorus retention, \*Agricultural reservoirs, \*Soil nutrients, Universal soil loss equation, Plant nutrients, Analytical procedures, Powerline reservoir, Murphy reservoir, Smith reservoir, Sediment retention.

Total N, total C, and readily available organic and inorganic P contents, and particle-size distributions were determined for samples of soils and sediments collected from three agricultural watersheds in north Mississippi. The total quantities of N, P, C, and clay accumulated in the sediments of each reservoir were calculated. These values were compared with those calculated from soil losses estimated by using the Universal Soil Loss Equation. The results showed considerable variation between the percentages of plant nutrients and of soil particles retained in the reservoirs. These reservoirs were highly effective in retaining eroded soil particles. However, the percentages of soil nutrients retained in the reservoir sediments were less than the percentages of retained soil particles. (Henley - ISWS) W76-12983

### VARIATION OF SUSPENDED SEDIMENT LOAD IN THE PALOUSE REGION OF THE NORTHWEST.

For primary bibliographic entry see Field 5G. W76-13012

### URBAN HYDROLOGY FOR SMALL WATERSHEDS.

Soil Conservation Service, Washington, D. C. Engineering Div. For primary bibliographic entry see Field 4C. W76-13044

### PREIMPOUNDMENT WATER QUALITY OF RAYSTOWN BRANCH JUNIATA RIVER AND SIX TRIBUTARY STREAMS, SOUTH-CENTRAL PENNSYLVANIA.

Geological Survey, Harrisburg, Pa. For primary bibliographic entry see Field 5A. W76-13065

### ESTIMATING PEAK DISCHARGES FROM SMALL DRAINAGES IN NEVADA ACCORDING TO BASIN AREAS WITHIN ELEVATION ZONES.

Geological Survey, Carson City, Nev. For primary bibliographic entry see Field 4A.

# WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

## Identification Of Pollutants—Group 5A

W76-13080

**AN OVERVIEW OF THE PRECIPITATION PROCESSING SYSTEM AT THE SOUTHWEST WATERSHED RESEARCH CENTER,** Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center. For primary bibliographic entry see Field 7C. W76-13132

**GEOMORPHOLOGY AND CLIMATOLOGY OF ARID WATERSHEDS,** Hebrew Univ., Jerusalem (Israel). Dept. of Geography. For primary bibliographic entry see Field 2A. W76-13135

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

### 5A. Identification Of Pollutants

**AN ASSESSMENT OF THE AIRBORNE EMISSION OF SELECTED VIRUSES BY WASTE-WATER TREATMENT FACILITIES,** Michigan Univ., Ann Arbor. K. F. Fannin. Available from University Microfilms, Inc., Ann Arbor, Mich., 48106. Order No. 76-10,297. Ph.D. Thesis, 1976, 123 p.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Activated sludge, \*Viruses, \*Trickling filters, \*Sewage, Treatment facilities, Bacteriophage, Coliforms, \*Air pollution. Identifiers: Animal viruses.

Airborne emission of viruses causing cytopathic effect (CPE) in monkey kidney cells, coliform bacteria, and bacteriophages forming plaques on two *Escherichia coli* strains from trickling filter and activated sludge waste water treatment plants were assessed. Large volume air samplers, with an attached recirculation apparatus, and Anderson samplers were used for field sampling. Low levels of bacteriophage emissions were observed, but animal viruses were not detected in aerosols. Concentrations of bacteriophages in sewage and their levels in air were compared. This ratio was then compared with sewage animal virus levels to estimate minimal airborne animal virus concentrations. These estimates are less than the sensitivity of the procedures used. The susceptibility to infection and density of the exposed downwind population should be considered in interpreting these estimates' significance. The effects of meteorological conditions on airborne bacteriophage and coliform bacteria recovery were observed. There were significant correlations between relative humidity and bacteriophage recovery and between wind speed and coliform bacteria. There was an inverse correlation between temperature and coliform bacterial levels. Coliform bacteria do not seem appropriate as indicators of viral air pollution, since their survival was lower than that of bacteriophages. Bacteriophages probably would better indicate this type of pollution. (Snyder-FIRL)

W76-12678

**SURVEY FOR RADIOACTIVITY IN A SWAMP,** Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Plant. For primary bibliographic entry see Field 5C. W76-12689

**STUDY OF FEDERAL WATER QUALITY MONITORING EFFICIENCY,** Enviro Control, Inc., Rockville, Md. For primary bibliographic entry see Field 5G. W76-12697

**ENVIRONMENTAL TRACE MATERIALS: COMPUTER COUPLED RADIOACTIVATION ANALYSIS,** Environmental Research Lab., Corvallis, Oreg. M. H. Feldman, D. E. Cawfield, and K. V. Byram. Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 105, \$4.00 in paper copy, \$3.00 in microfiche. Report EPA-600/3-75-015, December 1975, 42 p, 9 tab, 5 fig, 29 ref.

Descriptors: \*Radioactivity techniques, \*Trace elements, Tracers, Monitoring, Analytical techniques, Sludge, Sediments, Freshwater, \*Pollutant identification.

Radiation methodologies for environmental trace materials research, in particular neutron activation or the equivalent x-ray spectroscopic methods, were found to be feasible at laboratories with access to suitable irradiation sources. Neutron activation analysis is desirable for environmental tracer experiments because of its sensitivity and its use of constituent tracer nuclides rather than the introduction of other tracers. Samples used in these studies ranged from sewage treatment plant sludges and marine sediments to fresh waters containing very low concentrations of molybdenum, and ores and fertilizers containing cadmium. Gold, silver, and chromium were found to be useful elements for sludge tracing. (Chilton-ORNL) W76-12712

**THERMAL EFFECTS ON THE ACCUMULATION OF ARSENIC IN GREEN SUNFISH, LEPOMIS CYANELLUS,** Texas Univ. at Austin. Dept. of Zoology. For primary bibliographic entry see Field 5C. W76-12731

**TEMPERATURE RESPONSES OF A COCCOLITHOPHORID, CRICOSPHAERA CARTERAE, MEASURED IN A SIMPLE AND INEXPENSIVE THERMAL-GRADIENT DEVICE,** Duke Univ., Beaufort, N.C. Marine Lab. W. F. Blankley, and R. A. Lewin. Limnology and Oceanography, Vol. 21, No. 3, p 457-462, 1 fig, 13 ref.

Descriptors: \*Laboratory equipment, \*Temperature, Growth rates, Aquatic life, Apparatus, Thermal stress, Measurement, Instrumentation, \*Pollutant identification.

A device is described which produces a range of temperatures along a gradient, is of simple construction and low cost. The gradient can be set to include temperatures between 5 and 45 C. Experiments performed with the device described identified the temperature range for growth of *Cricosphaera carterae* to be 10-26 C with a maximal growth rate at 20 C. (Chilton-ORNL) W76-12764

**MEASUREMENTS OF PHYSICAL PHENOMENA RELATED TO POWER PLANT WASTE HEAT DISCHARGES: LAKE MICHIGAN, 1973 AND 1974,** Argonne National Lab., Ill. For primary bibliographic entry see Field 5B. W76-12770

**TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: JULY - SEPTEMBER 1975,** Mound Lab., Miamisburg, Ohio. For primary bibliographic entry see Field 5D. W76-12779

**TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: JANUARY - MARCH 1975,** Mound Lab., Miamisburg, Ohio. For primary bibliographic entry see Field 5D.

W76-12780

**GROUND-WATER BASIC DATA FOR DUNN COUNTY, NORTH DAKOTA,** Geological Survey, Bismarck, N. Dak. For primary bibliographic entry see Field 7C. W76-12786

**MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED BY THE U. S. ENVIRONMENTAL DATA SERVICE, AND BY THE U. S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,** Geological Survey, Denver, Colo. For primary bibliographic entry see Field 7C. W76-12794

**GEOCHEMICAL CONTROLS ON LEAD CONCENTRATIONS IN STREAM WATER AND SEDIMENTS,** Geological Survey, Menlo Park, Calif. J. D. Hem. *Geochimica et Cosmochimica Acta*, Vol 40, p 599-609, 1976. 5 fig, 1 tab, 29 ref, append.

Descriptors: \*Geochemistry, \*Lead, \*Streams, \*Sediments, \*Cation exchange, Mathematical models, Solubility, Heavy metals, \*Path of pollutants, \*Pollutant identification.

The equilibrium distribution of lead in solution and adsorbed on cation exchange sites in sediment theoretically may be calculated from equations representing selectivities of substrate for lead over H, Ca, and Na, and the stabilities of lead solute species. Such calculations include consideration of total concentrations of major ions, cation exchange capacity (CEC) of substrate, and pH, at values expected in various natural systems. Measurements of CEC and selectivity coefficients were made for synthetic halloysite, a finely divided amorphous 1:1 clay prepared by precipitation from a mixture of solutions of aluminum and silica. Where suspended sediment having the same properties is present in concentrations of 10-1,000 mg/liter at pH 6-8, more than 90% of the lead present can be adsorbed on sediment surfaces. The cation exchange behavior of lead and other minor cationic species in natural systems could be predicted by this type of model if enough other supporting information were available. Information of the type needed describing natural stream sediments, however, is presently inadequate for accurate predictions. (Woodward-USGS) W76-12800

**A PLAN FOR STUDY OF WATER AND ITS RELATION TO ECONOMIC DEVELOPMENT IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING,** Geological Survey, Cheyenne, Wyo. For primary bibliographic entry see Field 6D. W76-12805

**DATA ON SELECTED LAKES IN WASHINGTON, PART 4,** Geological Survey, Tucson, Ariz. For primary bibliographic entry see Field 7C. W76-12808

**ORGANICS IN DRINKING WATER. PART II. MASS SPECTRAL IDENTIFICATION DATA,** Ames Lab., Iowa. G. A. Junk. Available from the National Technical Information Service, Springfield, VA 22161 as IS-3672, \$5.00 in paper copy, \$3.00 in microfiche. Report IS-3672, July 1975, 80 p, 1 tab, 6 ref. W-7403-eng-82.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Descriptors: \*Data collections, \*Organic compounds, \*Spectroscopy, Analytical techniques, \*Pollutant identification.

The report is presented in a tabular form, ordered by increasing molecular weights. The table contains the 8 peak mass spectral data for 352 chemicals which have been identified in water. An additional 27 specific chemicals are also listed for which mass spectral data are not available. The table is intended for use by analytical chemists involved in the assay of water for trace organic constituents. (See also W76-03850) (Chilton-ORNL) W76-12812

**REMOTE SENSING STUDY OF MAUMEE RIVER EFFECTS ON LAKE ERIE**, National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center. R. Svehla, C. Raquet, D. Shook, J. Salzman, and T. Coney. Report No. NASA TM X-71780, July 1975. 26 p, 9 fig, 1 tab, 2 ref, 4 append.

Descriptors: \*Remote sensing, \*Water quality, \*Ohio, \*Pollutants, \*Lake Erie, Aircraft, Ships, Infrared radiation, Sampling, On-site investigations, Suspended solids, Pollution, Water pollution sources, Path of pollutants, Measurement, Instrumentation, Pollutant identification. Identifiers: \*Maumee River(Ohio).

A preliminary report of a pilot study of the effects of river inputs on boundary waters was presented. The study was done in support of Task D of the Pollution from Land Use Activities Reference Group of the International Joint Commission. Task D has the responsibility to assess the significance of river inputs into receiving waters, dispersion of pollutants, and the effects on water quality. The objective of this effort was to assess the effects of the spring runoff of the Maumee River on Lake Erie by a combination of ship survey and remote sensing techniques. Imagery obtained from a multispectral scanner of the west basin of Lake Erie was presented and discussed. The imagery clearly showed the distribution of particulate throughout the covered area. This synoptic view, in addition to its qualitative value, can be very useful in selecting sampling stations for shipboard in situ measurements, and for extrapolating these quantitative results throughout the area of interest. (Sims-ISWS) W76-12819

**CHEMICAL DYNAMICS OF A POLLUTED WATERSHED, THE MERRIMACK RIVER IN NORTHERN NEW ENGLAND**, Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences. For primary bibliographic entry see Field 5B. W76-12833

**ATMOSPHERIC INPUT OF SOME CATIONS AND ANIONS TO FOREST ECOSYSTEMS IN NORTH CAROLINA AND TENNESSEE**, Forest Service (USDA), Franklin, N.C. Coweeta Hydrologic Lab. For primary bibliographic entry see Field 2K. W76-12838

**FUNDAMENTAL STUDY ON THE POST TREATMENT OF RO PERMEATES FROM ARMY WASTEWATERS**, Illinois Univ. at Urbana-Champaign. Dept. of Environmental Engineering. For primary bibliographic entry see Field 5D. W76-12851

**REVIEW AND EVALUATION OF AVAILABLE TECHNIQUES FOR DETERMINING PERSISTENCE AND ROUTES OF DEGRADATION**

**OF CHEMICAL SUBSTANCES IN THE ENVIRONMENT**, Syracuse Univ. Research Corp., N. Y. Life Sciences Div. P. H. Howard, J. Saxena, P. R. Durkin, and L. T. Ou. Available from the National Technical Information Service, Springfield, VA 22161 as PB-243 825 \$13.50 in paper copy, \$3.00 in microfiche. Report EPA-560/5-75-006, May, 1975. 549 p, 54 fig, 48 tab, 745 ref.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Sewage treatment, \*Biological treatment, \*Activated sludge, Sewerage, Analytical techniques, Biochemical oxygen demand. Identifiers: Degradation testing.

Techniques used to study the persistence and breakdown of chemicals in the environment are reviewed, based on information from papers, books, review articles, and abstracting and computer services. A cost analysis of the techniques was also undertaken. The quality and quantity of the information varied considerably; pesticides and detergents in water and sewage were intensively studied. A relationship between environmental persistence and chemical structure is presented, with some theoretical grounds for such correlations. An attempt was made to categorize chemicals by suitable test methods. Precise criteria for evaluating environmental stability are lacking. There are three types of degradation: biodegradation, photochemical degradation, and chemical degradation. In contrast to the others, biodegradation generally yields completely mineralized end products. Biochemical oxygen demand (BOD) is frequently used for rapid screening. The river die-away test monitors the disappearance of the test chemical in natural water. Shake culture tests can use either mixed or pure cultures. Semicontinuous and miniature continuous models of activated sludge systems and models of trickling filter and anaerobic systems can measure biodegradability in sewage treatment systems. Determining biodegradation routes requires several methods, often involving cell-free extracts. Photochemical processes except in the atmosphere are poorly understood. Chemical degradation of some compounds should be studied in sterilized media. Because laboratory biodegradability studies are qualitative, they are relatively less important for metal compounds, many of whose reactions are reversible. (Snyder-FIRL) W76-12865

**A VIRUS-IN-WATER STUDY OF FINISHED WATER FROM SIX COMMUNITIES**, Health Effects Research Lab., Cincinnati, Ohio. Water Quality Div. E. W. Akin, D. A. Brashear, and N. A. Clarke. Available from the National Technical Information Service, Springfield, VA 22161 as PB-246 042, \$4.00 in paper copy, \$3.00 in microfiche. Report EPA-600/1-75-003, September, 1975. 18 p, 9 tab, 4 ref.

Descriptors: \*Pollutant identification, \*Treatment facilities, \*Analytical techniques, \*Viruses, \*Municipal water, Cities, Ohio, Indiana, Missouri, \*Water treatment, Public health.

Six sites were chosen for a study of virus in water. They were Columbus, Ohio; Sidney, Ohio; Muncie, Indiana; Seymour, Indiana; Kansas City, Missouri, and St. Joseph, Missouri. Sites were selected on the basis of a treatment plant's use of surface source water with domestic contamination as indicated by high fecal coliform counts. An effort was also made to select sites using conventional procedures for flocculation or softening. Plants of various sizes, as indicated by output volumes, were chosen. The study was carried out to determine if the procedures and equipment presently available could detect human enteric viruses, and to test virus-sampling procedures and equipment in the field. A flow-through virus-ad-

sorbent system was used. If viruses were present in these waters, the numbers were below the detectable level of a sensitive viruses recovery procedure. (Snyder-FIRL) W76-12866

**HANDBOOK FOR EVALUATING WATER BACTERIOLOGICAL LABORATORIES**, Municipal Environmental Research Lab., Cincinnati, Ohio. E. E. Geldreich.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-247 145, \$7.50 in paper copy, \$3.00 in microfiche. Report EPA-670/9-75-006, August, 1975. 206 p, 6 fig, 11 tab, 319 ref.

Descriptors: \*Pollutant identification, \*Analytical techniques, \*Potable water, \*Water supply, \*Laboratories, \*Evaluation, Bacteria, Publications, Water quality standards, Personnel, Data collection.

Identifiers: \*Bacteriology handbooks.

The material included is designed to provide a comprehensive source of information and reference for the evaluation of laboratories involved in bacteriological testing of potable water supplies and their sources. A similar document published by the Public Health Service in 1966, based on experience in evaluating bacteriological laboratories responsible for the examination of water supplies, is updated and expanded. Material and media preparation, equipment needs and specifications, sample collection and handling, bacteriological methodology, quality control considerations, laboratory management, and the qualifications and responsibilities of the survey officer are considered. Specific topics include monitoring response, multiple tube coliform procedures, and membrane filter coliform procedures. The handbook is intended to assist in the evaluation of the many aspects of the laboratory that are involved in attaining reliable data. Testing of natural recreational waters, streams, sediments and sludges as well as potable water sources is included. (Snyder-FIRL) W76-12869

**TECHNIQUES FOR OPTIMIZING A QUADRUPOLE GC/MS/COMPUTER SYSTEM**, Environmental Research Lab., Athens, Ga. M. H. Carter. Report EPA-600/4-76-004, March, 1976. 33 p, 11 fig, 6 ref, 2 append.

Descriptors: \*Pollutant identification, \*Analytical techniques, \*Optimization, Computers, Organic compounds, Stability, Gas chromatography, Mass spectrometry, Instrumentation.

Using experience gained during 4 years of analyzing various types of organic pollutants, techniques and procedures were developed to maintain the stability and maximize the sensitivity of the Finnigan 1015-System 150 Gas Chromatograph/Mass Spectrometer/Computer (GC/MS/Computer) System. Poor vacuum tube performance and high temperature in the electronics chassis can cause instability. Appropriate maintenance and adjustment techniques maximize sensitivity. Appropriate operator techniques are essential in maintaining sensitivity and stability. Methods developed for increasing the utility of the data collected by the GC/MS/Computer system include techniques for acquiring better data and for extracting the most information from the data that have been acquired. Operator actions can significantly improve the utility of the data. (Snyder-FIRL) W76-12870



**RECOMMENDED DESIGN OF SAMPLE INTAKE SYSTEMS FOR AUTOMATIC INSTRUMENTATION.**

Environmental Monitoring and Support Lab., Cincinnati, Ohio.  
R.P. Lauch.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 733, \$4.00 in paper copy, \$3.00 in microfiche. Report EPA-600/4-75-012, November, 1975. 29 p, 4 fig, 6 tab, 7 ref.

Descriptors: \*Pollutant identification, \*Pumps, Waste water (Pollution), \*Water quality, \*Intakes, Water pollution, \*Instrumentation, Monitoring, \*Design criteria, \*Automation, \*Automatic control.

The biochemical and mechanical reasons for sample change on intake systems were studied. Tests were made on different types of pumping systems. Experimental data showed sample degradation because of biological metabolism, cavitation, and aeration. Samples drawn from the river channel are usually representative of most of the water in the stream. High sample velocity through a pipeline of consistent cross section is required, because sample degradation resulting from biological metabolism of sludge and slime microbes within the pipeline should be insignificant. Raw water should flow directly from the river through a pump and to the instrumentation shelter. A positive pressure system with low residence time minimizes mechanical sample change due to cavitation, reaeration, and damping. A system designed for minimal biological sample degradation may not require automatic cleaning. Above a certain velocity for a specific line length and exposed internal surface, biological degradation is insignificant. Cursor results show that an optimum velocity is attainable that would eliminate the need for automatic cleaning. Initial design should be aimed toward this optimum system. Access to the intake strainer should be easy, because periodic manual cleaning is required. The design must consider system maintenance. All components must be accessible from the river bank during the most adverse stream conditions. (Snyder-FIRL)  
W76-12871

**DESIGN AND TESTING OF A PROTOTYPE AUTOMATIC SEWER SAMPLING SYSTEM.**

EG and G Washington Analytical Services Center, Inc., Rockville, Md.  
P.E. Shelley.

Report EPA-600/2-76-006, March, 1976. 106 p, 27 fig, 2 tab, 12 ref, append.

Descriptors: \*Pollutant identification, \*Sewerage, \*Sampling, \*Sewage, \*Water analysis, Water quality, Water pollution, Effluents, Storm drains, Combined sewers, Sanitary engineering, Waste water treatment.

The characteristics of storm and combined sewer flows are briefly reviewed. These are difficult to accurately characterize in a water quality sense due to the wide range of pollutants, the possible spatial variations within a cross-section of the flow, widely varying flow rates, the frequent presence of significant bed load, and debris which may harm the sampler. The requirements for samplers are discussed. Due to the large number of highly varying parameters, a systems approach to designing an automatic sampler is virtually mandatory; the essential elements of such a system are the sampler, intake subsystem, the sample gathering subsystem, the sample transport subsystem, the sample storage subsystem, and the controls and power subsystem. A new automatic sewer sampling system was built using a modular approach, which allows the basic design implementation to be tailored to suit various sampling and site requirements. It incorporates all solid-state electronics, a clock for time correlation, high sample intake and transport velocities, large peristaltic

pumps and fluidic diverters to avoid moving parts in the sample train, the return of the first flow to waste, a fresh water purge and backflush before and after collecting each sample, multilevel sample intakes with non-intrusive mounting, and large sample capacity. The prototype performed well when field tested in a sewer. It was also tested with synthetic sewage under laboratory conditions and found capable of gathering reasonably representative samples over a range of flow characteristics. Four commercial samplers were tested side by side with the prototype under laboratory conditions and their results ranged from an overall understatement of pollutant loading by 25% to overstatements of 200%. (Snyder-FIRL)  
W76-12872

**ISOLATING ORGANIC WATER POLLUTANTS: XAD RESINS URETHANE FOAMS, SOLVENT EXTRACTION.**

Environmental Protection Agency, Athens, Ga. Southeast Environmental Research Lab.  
R.G. Webb.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-245 647, \$4.00 in paper copy, \$3.00 in microfiche. Report EPA-600/4-75-003, June, 1975. 21 p, 2 fig, 2 tab, 12 ref.

Descriptors: \*Pollutant identification, \*Analytical techniques, \*Separation techniques, \*Solvent extractions, \*Resins, Adsorption, Chromatography, Drying, Gas chromatography, Organic wastes, Oily water, Pulp wastes, Dyes, \*Isolation. Identifiers: Kuderna-Danish evaporator.

Macrorotational resins (XAS-resins) and urethane foams were investigated as adsorbents for the isolation of organic pollutants from water. The procedures and reagents for solvent extraction were also examined for inefficiencies. XAD-2, 4, 7, and 8 and various mixtures effectively extracted a broad range of individual industrial pollutants and mixtures typical of paper mill waste waters, dissolved fuel oil, and textile dyes. Typical resin recovery efficiencies were 65 to 75% for individual compounds; direct chloroform extraction efficiency was 80%. These resins may be useful in long term or composite sampling. Polyurethane foams were not effective in extracting many compounds found in industrial effluents, although they function well for PCB's. Either chloroform or methylene chloride is generally recommended over diethyl ether or hexane as an extraction solvent. Drying of chloroform extracts before evaporation was shown to be unnecessary; drying with sodium sulfate or glass wool resulted in lower recoveries than direct concentration without drying. For typical industrial effluents, extract concentration to 10 ml with a Kuderna-Danish evaporator and to as low as 0.3 ml with a micro-Snyder column resulted in greater recovery of dissolved organics than did rotating evaporators and airstream-waterbath methods. Extraction with tetralin sometimes allows nonpolar low-boiling pollutants to be detected that are usually obscured in gas chromatographic analysis by the solvent peak. (Snyder-FIRL)  
W76-12873

**ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES—MIDDLE ATLANTIC BIGHT.**

Environmental Protection Agency, Annapolis, Md. Annapolis Science Center.

For primary bibliographic entry see Field 5B.

W76-12875

**MEASUREMENT AND PERSISTENCE OF CHLORINE RESIDUALS IN NATURAL WATERS.**

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 43-71, 5 tab, 8 fig, 25 ref. DADA 17-72-C-2053.

Descriptors: \*Water pollution treatment, \*Waste water treatment, Water chemistry, Analytical techniques, \*Chlorine, \*Measurement, \*Disinfection, Oxidation, \*Pollutant identification, \*Chlorination.

The distinction is made between good disinfectant compounds and those compounds of chlorine which are poorer as disinfectants. Hypochlorous acid is identified as a good disinfectant. Chlorine residual is identified as the concentration of all oxidizing agents produced by chlorination and remaining sometime afterward whether these oxidizing agents contain chlorine or not. The nature and persistence of chlorination products classed as chlorine residuals are discussed by type of compound. Present field, laboratory and continuous methods for determining free and combined chlorine residual are compared for specificity, reagent stability, accuracy and simplicity. A new analytical method specific for HOCl or NH<sub>2</sub>Cl in the presence of the poor disinfectants, hypochlorite, organic chloramines and other interferences is presented. (See also W76-12876) (Chilton-ORNL)  
W76-12879

**CHLORINATION OF ORGANICS IN COOLING WATERS AND PROCESS EFFLUENTS.**

Oak Ridge National Lab., Tenn.

R. L. Jolley, G. Jones, W. W. Pitt, and J. E. Thompson.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 115-152. 9 fig, 6 tab, 69 ref.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Sewage treatment, \*Analytical techniques, \*Treatment facilities, Chlorination, Organic compounds, Cooling water, Effluents.

Available information concerning organic constituents in natural waters, including effluents from sewage treatment plants, is reviewed. Selected aspects of aqueous chlorination are discussed. Previous chlorination studies with sewage effluents and cooling water are summarized, and results from a recent study with a sample of cooling water are presented. Many water-soluble chlorine-containing organic compounds of low volatility were found in samples of chlorinated cooling waters from electric power-generating plants and chlorinated effluents from domestic sanitary sewage treatment plants. Both types of samples were chlorinated to milligram-per-liter chlorine concentrations in the laboratory under conditions similar to those used for treating cooling waters and disinfecting sewage effluents. High-pressure liquid chromatography was used to separate the chlorinated constituents from concentrates of the water samples. Chlorination yields (as Cl) of the chloro-organic compounds ranged from 0.5 to 3.1% of the chlorine dosage. The formation of chloro-organics and the reaction yields correlated with the chemical compositions of the samples. Several chloro-organics were quantified at the microgram-per-liter level in the domestic sewage effluents. A high degree of correspondence with respect to the elution positions of the separated constituents was revealed by comparison of the chromatograms of the chlorinated constituents in the cooling water samples with those of the sewage process effluent samples. (See also W76-12876) (Snyder-FIRL)  
W76-12882

**ANALYSIS OF NEW CHLORINATED ORGANIC COMPOUNDS FORMED BY**

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

#### CHLORINATION OF MUNICIPAL WASTE-WATER,

North Texas State Univ., Denton. Inst. of Applied Sciences.  
W. H. Glaze, J. E. Henderson IV, and G. Smith.  
In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 153-175. 9 fig, 4 tab, 14 ref.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Analytical techniques, \*Organic compounds, \*Chlorination, \*Waste water (Pollution), Municipal wastes, Chlorine, Texas, Spectrometry.  
Identifiers: Chlorinated organic compounds.

Recent data on the formation of new chlorinated organics, particularly with the use of large doses of chlorine (1000 to 4000 mg/liter) are described. Two analytical techniques were used to investigate the effect of chlorination on secondary municipal waste water effluents. Total organic-bound chlorine (TOCl) is measured before and after chlorination by a microcoulometric procedure, whose development is reported. Extracts of the effluent before and after chlorination at various dosages are pyrolyzed and titrated in the Dohrmann halide analyzer. The TOCl results show a significant increase in the level of organic-bound chlorine in municipal waste water after chlorination, particularly using large doses of chlorine (2000 to 4000 ppm). The concentrates obtained by XAD-2 resin extractions of the effluents were studied by gas chromatography/mass spectrometry. The results confirm that chlorination causes the formation of many new chlorinated organics; the structures of over 50 have been identified. Although most of the compounds are aromatic halides, many are not derivatives of 'activated' aromatics but are simple derivatives such as chlorobenzenes, -toluenes, and -alkylbenzenes. Nonaromatic chlorides were also identified. The TOCl and GC/MS results indicate that doses of chlorine in the range of 2000 to 4000 ppm cause a very large increase in organic-chlorine content. GC/MS data on XAD extracts of Denton, Texas, drinking water are also reported. The occurrence of three iodine containing compounds, dichlorodimethane, dibromodimethane, and bromochlorodimethane, in the finished water is of particular interest. (See also W76-12876) (Snyder-FIRL)  
W76-12883

#### CHEMISTRY OF HALOGENS IN SEAWATER,

Rosentel School of Marine and Atmospheric Science, Miami, Fla.  
J. H. Carpenter, and D. L. Macalady.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 177-193, 2 fig, 18 ref. EPA R 803893-01.

Descriptors: \*Sea water, \*Chlorination, Analytical techniques, Bromides, \*Halogens, \*Chlorine, Water chemistry, \*Pollutant identification.

The limited information available for reactions that occur when chlorine is added to seawater is discussed. Data shows that the widely used procedure for estimating residual chlorine of seawater samples is misleading and that the identification of the chemical species formed is a prerequisite to designing proper analytical methods. Present information suggests that the bromide ion is oxidized and disproportionate to several oxidation states. Formation of brominated or mixed brominated-chlorinated organic compounds can be expected but the extent and speciation of such reactions remain to be determined. (See also W76-12876) (Chilton-ORNL)  
W76-12884

#### CHLORINATED COMPOUNDS FOUND IN WASTE-TREATMENT EFFLUENTS AND THEIR CAPACITY TO BIOACCUMULATE,

Minnesota Univ., Duluth. Dept. of Chemistry.  
H. L. Köpperman, D. W. Kuehl, and G. E. Glass.  
In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 327-345. 4 fig, 7 tab, 21 ref.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Sewage treatment, \*Analytical techniques, Sewage effluents, Disinfection, Minnows, Absorption, \*Chlorination.

Identifiers: Chlorinated compounds, \*Bioaccumulation.

To assess possible long-term environmental effects due to the formation of stable reaction products during disinfection processes, fathead minnows and water from the 9 month chronic toxicity tests at two waste water treatment plants were analyzed for chemical residues. Gel permeation chromatography was used for sample clean-up and gas chromatography/mass spectrometry for sample analysis. Di- and trichlorophenols, di- and trichlorobenzenes, and trichloroanisoles were detected at lower levels, if at all, in the fish from nondisinfected effluent exposures as compared to fish exposed to chlorinated effluent. All fish raised in the sewage effluent contained tetra- and pentachlorophenols, PCB's, DDT's, toxaphene components, chlordane, and nonachlor. Tribromoanisole was tentatively identified in fish that lived in waste water treated with bromine chloride. The incorporation of chlorine into compounds when it is used to disinfect effluents is an undesirable end result of effluent treatment in that compounds become more persistent and bioaccumulate to a greater extent. (See also W76-12876) (Snyder-FIRL)  
W76-12891

#### MICROBIOLOGY - DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES, (LITERATURE REVIEW),

Environmental Research Center, Cincinnati, Ohio.  
G. Berg.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1410-1416, June, 1976. 44 ref.

Descriptors: \*Viruses, \*Microbiology, \*Potable water, \*Pollutant identification, \*Waste water treatment, Diseases, Epidemiology, Adsorption, Filters, Temperature, Coagulation, Filtration, Bioindicators, Coliforms, Reviews, \*Bibliographies.

Identifiers: Hepatitis, Poliovirus, Coliphages, \*Literature reviews.

A literature review of papers dealing with the detection, occurrence, and removal of viruses from water is presented. General topics covered include: methods for recovering viruses from water, virus survival, water-related disease outbreaks, the removal of viruses by treatment processes, and indicators of viruses. Specific subjects discussed under the above general headings include: the effectiveness of adsorbent filters for recovering poliovirus 1 from large volumes of seeded finished drinking water, the inactivation of coliphage f2 viruses in waste water and drinking water at various temperatures, the recovery of an attenuated strain of poliovirus 3 from a finished water sample taken from a treatment plant, waterborne outbreaks of hepatitis, the use of coagulation with iron chloride and rapid sand filtration to remove poliovirus 1 in seeded synthetic water, and the usefulness of coliforms as indicators of viruses. (Kreager-FIRL)  
W76-12896

#### STUDY ON THE EFFICIENCY OF FOUR PROCEDURES FOR ENUMERATING COLIFORMS IN WATER,

Canada Centre for Inland Waters, Burlington (Ontario).

B. J. Dutka, and S. E. Tobin.  
Canadian Journal of Microbiology, Vol. 22, No. 5, p 630-635, 1976. 5 tab, 8 ref.

Descriptors: \*Pollutant identification, \*Analytical techniques, \*Sewerage, \*Effluents, \*Coliforms, Efficiencies, Estimating, Bacteria, Laboratory tests.

Four coliform estimation procedures were compared as to their ability to enumerate coliform bacteria from sewage, effluent, and various fresh waters in the lower Great Lakes Region of Canada. The procedures included a most probable number (MPN) technique using lauryl tryptose broth (LST) and brilliant green bile 2% broth (BGB), a membrane filtration (MF) technique using m Endo agar LES, an MPN technique using Parhad chemically defined synthetic medium (PCDS) and BGB developed for Indian fresh waters, and an MF(mC agar) technique developed for seawater. Within the survey area, maximum population estimates generally were achieved by the MF procedure using m Endo agar LES. The MPN procedure with the LST-BGB combination appears to provide the best estimates of raw sewage coliform densities. It estimates about double the population of its closest competitor, PCDS-BGB-MPN technique. Each procedure was selective for different genera of the Enterobacteriaceae. (Snyder-FIRL)  
W76-12897

#### LABORATORY EVALUATION OF POLYMERIC FLOCCULANTS,

McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.  
For primary bibliographic entry see Field 5D.  
W76-12898

#### QUANTITATIVE DETERMINATION OF ASBESTOS FIBER CONCENTRATIONS,

Dow Chemical Co., Midland, Mich.  
D. R. Beaman, and D. M. File.  
Analytical Chemistry, Vol. 48, No. 1, p 101-110, January, 1976. 7 fig, 3 tab, 22 ref.

Descriptors: \*Asbestos, \*Analytical techniques, \*Pollutant identification, \*Measurement, Electron microscopy, Water analysis, Methodology.  
Identifiers: \*Asbestos fibers, Chrysotile fibers, Amphibole fibers, Selected area electron diffraction, Energy dispersive spectrometer, Vacuum filtration.

A method of measuring the concentration of asbestos fibers in filterable liquids and solid matrices is presented. In the described method, fiber identification is based on the almost simultaneous determination of the morphology, elemental composition and crystal structure. This is accomplished by using a transmission electron microscope (TEM) equipped with selected area electron diffraction (SAED) and an energy dispersive spectrometer (EDS). Sample preparation, instrumentation and procedure are discussed. Water samples underwent vacuum filtration. Experiments were conducted to determine how much fiber was lost during sample preparation. The mean loss of amphibole fiber for eight different tests was 45% and the mean loss for chrysotile fiber after eleven different tests was 11%. Chrysotile is less prone to wash off than amphibole. Results showed that 40 to 100% of the chrysotile fibers in water samples have distinctive tubular morphology. Identifiable SAED patterns were observed for about 30% of the chrysotile fibers and 60% of the amphibole fibers. By applying corrections for SAED ambiguities and losses during sample preparation and by making allowances for the dependence of fiber composition on fiber size, it was possible to measure asbestos fiber concentrations with a precision of plus or minus 30%. A classification scheme was developed to establish maximum and minimum limits of fiber concentration for each sample. (Pinto-FIRL)

W76-12899

# **NASA TO TEST NEW TECHNIQUES FOR ON-STREAM WATER MONITORING.**

Instrumentation Technology, Vol. 23, No. 6, p 17, June, 1976.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Sewage treatment, \*Analytical techniques, \*Monitoring, Coliforms, Water types, Automation, Evaluation.

Techniques developed by the National Aeronautics and Space Administration (NASA) to detect microorganisms in water systems on manned spacecraft are being adapted to detect harmful bacteria in the treated water of cities. The new processes are incorporated in an Automated Water Monitoring System to be evaluated for one year in cooperation with the Gulf Coast Waste Disposal Authority, which is responsible for sewage treatment in three southeast Texas countries. The electronic system will monitor treated water for such components as dissolved oxygen, total oxygen demand, total organic carbon, bacteria, chlorides, residual chlorine, ammonia, nitrate, total nitrogen, sodium, water temperature, turbidity, conductivity, hardness, and acidity or alkalinity. The system can be adapted to process data from up to 40 water sensors. In the initial evaluation, 24 sensors will be used. By adding chemicals which cause bacteria to radiate light, researchers have developed a sensor that gives total bacteria count directly. A device has also been developed that can detect human and nonhuman fecal coliform bacteria in a few hr. The monitoring system eventually will include an instrument to rapidly and automatically detect organic chemicals known to produce cancer in lab animals. A gas chromatograph technique, originally developed to extract small quantities of organic materials from the atmospheres of other planets, is being adapted to concentrate these chemicals for rapid analysis. Research is also in progress on a technique, using fluorescent dyes, designed as a method of detecting life in space, which might be applied to the detection of viruses in water. (Snyder-FIRL)

W76-12900

# **CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES, (LITERATURE REVIEW).**

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.  
P. L. Brezonik, and N. E. Carriker.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1077-1086, June, 1976. 87 ref.

Descriptors: \*Analytical methods, \*Pollutant identification, \*Sampling, \*Bioassay, Colorimetry, Turbidity, Chemical oxygen demand, Chlorides, Sulfides, Organic compounds, Inorganic compounds, Carbon, Fish, Toxicity, \*Monitoring, Potable water, Instrumentation, Electrochemistry, Chlorine, Reviews, \*Bibliographies.  
Identifiers: Potentiometric methods, Amperometric methods, Spectrometric methods, \*Literature reviews.

A review of literature dealing with continuous water quality monitoring, automated analysis, and sampling procedures is presented. General topics covered include: the use of electrometric and spectrometric methods for analyzing inorganic substances, techniques for measuring oxygen demand and organic matter and for performing bioassays and methods and instrumentation for collecting and preserving water samples. Examples of specific topics discussed under the above general heading include: the use of amperometric methods for residual chlorine determination, the use of potentiometric electrodes for monitoring cations and anions in industrial waste waters, colorimetric methods for chloride and sulfide determinations, turbidity monitoring with a dual

beam optical transmissometer, semiautomated procedures for chemical oxygen demand, automated flow-through procedures for measuring dissolved organic carbon in natural waters, device for monitoring toxic substances when fish are used as the assay organisms, evaluation of commercially available waste water samplers, and sampling and preservation procedures for nitrogen species in drinking water supplies. (Kreager-FIRL)

W76-12902

# **AIRBORNE COLIPHAGES FROM WASTE-WATER TREATMENT FACILITIES.**

Michigan Univ., Ann Arbor. School of Public Health.  
K. F. Fannin, J. C. Spendlove, K. W. Cochran, and J. J. Gannon.  
Applied and Environmental Microbiology, Vol. 31, No. 5, p 705-710, May, 1976. 6 tab, 30 ref.

Descriptors: \*Air pollution, \*Viruses, \*Waste water treatment, \*Treatment facilities, Activated sludge, Trickling filters, Coliforms, Aerosols, Bacteria, Microorganisms, Analytical techniques, Pollutant identification.  
Identifiers: \*Coliphages (Air borne).

Waste water treatment plant emissions of airborne coliphages that form plaques on two strains of *Escherichia coli* were investigated. Two activated sludge and two trickling filter plants were investigated using large volume air samplers with recirculation devices. Coliphages were enumerated by a most probable number procedure. Average coliphage levels in the airborne emissions of trickling filter beds and activated sludge units were 0.284 and 0.302/cu m, respectively; sewage liquor concentrations from the above sources were 448,000 and 2.94 million plaque-forming units/liter, respectively, depending on the *Escherichia coli* host used for the assay. The isolation of low levels of coliphages from the airborne emissions of waste water treatment plants demonstrates that these viruses can survive natural aerosolization and may be recovered with the procedures used. (Kreager-FIRL)

W76-12921

# **FATE OF METALS IN WASTEWATER DISCHARGE TO OCEAN.**

CDM, Inc., Pasadena, Calif.  
For primary bibliographic entry see Field 5B.

W76-12927

# **SANITARY LANDFILL LEACHATES AND THEIR TREATMENT.**

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5D.

W76-12930

# **POLLUTANT AEROSOL DEPOSITION INTO SOUTHERN LAKE MICHIGAN.**

Illinois State Water Survey, Urbana. Atmospheric Sciences Section.  
For primary bibliographic entry see Field 5B.

W76-12935

# **ULTRASONIC REMOVAL OF EPILITHIC ALGAE IN A BARCLAMP SAMPLER.**

Ichthyological Associates, Inc., Berwick Pa.  
W. F. Gale.  
Journal of Phycology, Vol. 11, No. 4, p. 472-473, 1975. 1 fig., 1 tab., 1 ref.

Descriptors: \*Periphyton, \*Algae, \*Sampling, \*Rocks, \*Bottom sampling, Methodology, Design, Automation, Non-destructive tests, \*Ultrasonics, Standing crops, Pollutant identification.  
Identifiers: Bar-clamp sampler, \*Epilithic algae, Ultrasonic algae collection.

Standing crop estimates of epilithic algae are difficult to determine because it is not possible to collect quantitative samples of natural substrates in lakes and deep rivers. A bar-clamp sampler with an attached collecting cup is described which permits quantitative sampling of epilithic algae on stones 4-50 cm in diameter or larger or on artificial substrates in shallow or deep water. It is designed for SCUBA divers to use in turbid rivers too deep and swift for wading, but can be used in other habitats. It delimits the sampling area and encloses it, so algal cells cannot enter or be lost when handling or transporting stones and holds water in the sampling area, which prevents drying, helps dislodge materials during cleaning, and carries dislodged cells to collection jars. Ultrasonic vibration remove cells from stones (up to 62% of the total) missed by scraping and brushing. The method has been used for a year to remove algae from stones collected in the Susquehanna River. It has held up well in the field, is easy for a diver wearing thick neoprene mittens to manipulate, and facilitates cleaning by stabilizing the stone and rigidly maintaining the sampling area. Its design, construction, and application are described. (Buchanan-Davidson-Wisconsin)

W76-12939

# **THE OCCURRENCE OF ORGANIC MICROPOLLUTANTS IN THE RIVER RHINE AND THE RIVER MAAS IN 1974.**

Netherlands Waterworks, Rijswijk. Testing and Research Inst.  
A. P. Meijers, and R. C. van der Leer.  
Water Research, Vol. 10, No. 7, p 597-604, 1976. 10 fig., 8 tab.

Descriptors: \*Pollutant identification, \*Organic wastes, \*Water quality, Organic compounds, \*Pesticides, Surface waters, Chlorinated hydrocarbon pesticides, Oil wastes, Water properties, Water pollution sources, Chemical wastes, Analytical techniques, Gas chromatography, Analysis, Mass spectrometry, Water pollution, Chemistry, Instrumentation.

Identifiers: \*Organic micropollutants, \*Rhine River, \*Maas River, Pollution investigation, Organic pollutants, \*Waal River, Lindane, Chlorobenzene, Nitrobenzene, Analytical procedures, Organic groups, Infrared spectrometry, Aromatic bases, Oxygenated substances, Aromatic hydrocarbons.

For several years KIWA (Testing and Research Institute of the Netherlands Waterworks) has investigated the pollution of the river Rhine and river Maas for specific organic groups. A quantity of 20 l of water was extracted weekly with hexane, and the extract divided into several groups. The extracts were analyzed by gas chromatography and mass-spectrometry. The results of these investigations during 1974 were summarized and showed that the river Rhine is heavily polluted by oil, a number of aromatics and aromatic bases, and a number of oxygenated substances. It was also shown that the river Maas, however, is much less polluted by these substances with the exception of oil. (Henley-ISWS)

W76-12988

# **ATMOSPHERIC AEROSOLS: A LITERATURE SUMMARY OF THEIR PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION.**

Old Dominion Univ., Norfolk, Va. School of Sciences.  
F. S. Harris, Jr.  
Report NASA CR-2626, January 1976. 43 p, 1 tab, 199 ref. NGR 47-003-068.

Descriptors: \*Bibliographies, \*Air pollution, \*Aerosols, \*Pollutants, \*Atmosphere, Pollutant identification, Analytical techniques, Physical properties, Particle size, Spatial distribution, Temporal distribution, Salts, Organic compounds, Elements (Chemical), Saline water intrusion.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

This report contained a summary of 199 recent (1968-1975) references on the characterization of atmospheric aerosols with respect to their composition, sources, size distribution, and time changes, and with particular reference to the chemical elements measured by modern techniques, especially activation analysis. The literature review was made as a guide to the characterization of aerosols which would be useful in air quality measurements by NASA-LaRC and Old Dominion University in cooperation with Region VI, Virginia State Air Pollution Control Board. The purpose of the joint measurements is to learn what types of variables it would be useful to determine in addition to the usual mass loading and meteorological factors. This examination of recent literature, particularly with respect to the results of elemental analysis and other variables of interest, may be of use to others working in this field. For the varied experimental conditions and techniques employed, reference must be made to the original articles. No attempt was made to explain differences which resulted from different conditions and techniques. (Humphreys-ISWS) W76-12996

#### SAMPLERS FOR MONITORING RUNOFF WATERS,

Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.  
H. L. Manges, and C. C. Nixon.  
Presented at the 1975 Winter Meeting of the American Society of the Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 10 p, 4 fig, 9 ref. ASAE Paper 75-2562.

Descriptors: \*Runoff, \*Sampling, \*Water sampling, \*Water pollution sources, \*Water pollution control, \*Pollutant identification, \*Monitoring.

A sampler is badly needed for collecting a proportional sample of runoff water for laboratory analysis. Pollutant load in runoff would be calculated from sample volume and pollutant concentration measurements. A sampler was designed and built which divided flow with short tubes. In laboratory tests, sampling ratio became constant after decreasing with increasing flow rates for unsubmerged flow and was constant for submerged flow. Sampling ratio was quite variable during field testing because of debris clogging the reservoir below the short tubes. A sampler using orifices surrounded by short tubes in place of the short tubes alone for dividing flow had a slightly better sampling ratio for unsubmerged flow and a constant sampling ratio for submerged flow. (Skogerboe - Colorado State) W76-13006

#### PHYSICAL-CHEMICAL COMPOSITION OF ERODED SOIL,

Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 2J. W76-13010

#### PREIMPOUNDMENT WATER QUALITY OF RAYSTOWN BRANCH JUNIATA RIVER AND SIX TRIBUTARY STREAMS, SOUTH-CENTRAL PENNSYLVANIA,

Geological Survey, Harrisburg, Pa.  
D. R. Williams.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A027 387, \$4.00 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 76-57, June 1976. 23 p, 5 fig, 5 tab, 5 ref.

Descriptors: \*Water quality, \*Baseline studies, \*Pre-impoundment, \*Streams, \*Reservoirs, Sampling, Data collections, Chemical analysis, Water analysis, Soil analysis, Physical properties, Nutrients, Coliforms, Evaluation, \*Pennsylvania, Pollutant identification.  
Identifiers: \*Juniata River watershed(Penn), Raystown Branch(Penn).

The Raystown Branch Juniata River watershed, which is the main water source for Raystown Lake, is a 960-square-mile drainage basin in south-central Pennsylvania. Preimpoundment water-quality data were collected on the Raystown Branch and six tributary streams in the basin. Specific conductance values varied inversely with water discharge. The pH values were extremely low only at the Shoup Run site. Dissolved oxygen concentrations observed at all sites indicated a relatively high oxygen saturation level throughout the year. Seasonal variations in nitrate-N and orthophosphate-P levels were measured at the main inflow station, Saxton, Pa. The highest concentrations of nitrate-N and orthophosphate-P occurred in the winter and spring months and the lowest concentrations were measured during the summer and fall. Bacteriological data indicated no excessive amounts of fecal matter present at the inflows. Soil samples collected at four sites in the impoundment area were predominantly of the Barbour, Philo, and Basher series, which are considered to be highly fertile soils with silt-loam and sandy-loam textures. Morphological features of the lake basin and low nutrient levels at the inflows should prevent excessive weed growth around the lake perimeter. (Woodard-USGS) W76-13065

#### WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1975.

Geological Survey, Columbia, S. C.  
For primary bibliographic entry see Field 7C. W76-13066

#### WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1975.

Geological Survey, Raleigh, N. C.  
For primary bibliographic entry see Field 7C. W76-13067

#### OCCURRENCE OF ARSENIC IN THE DRY CREEK BASIN, SONOMA COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, Calif.  
R. F. Middelburg.  
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-028 020, \$3.50 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 76-30, May 1976. 17 p, 5 fig, 2 tab, 13 ref.

Descriptors: \*Water pollution sources, \*Arsenic compounds, \*Water quality, \*Pre-impoundment, \*Baseline studies, \*California, Lakes, Springs, Hot springs, Watershed management, Water chemistry, \*Pollutant identification.  
Identifiers: Sonoma County(Calif), \*Dry Creek basin, \*Arsenic.

An arsenic reconnaissance study was made from August through November 1974 in the Dry Creek basin in northern California where the U.S. Army Corps of Engineers proposes to construct Warm Springs Dam. The purpose was to determine the extent of any potential arsenic problems that may affect Lake Sonoma which would form behind the dam. Samples of sediment, water, and biota were collected and analyzed for arsenic content. Results indicate that arsenic presents a potential problem only in the Little Warm Springs Creek area where samples of geothermal water contained 140 micrograms of arsenic per liter of water. However, the contribution of arsenic to the lake will be minimal because discharge of the geothermal water in the area is estimated to be only about 0.01 cubic foot per second (0.0003 cubic meter per second). Analyses of limited numbers of biota samples indicated that there is no biomagnification of arsenic through the food chain. Concentrations of arsenic in biota were similar both in samples collected from water containing high levels of arsenic and those collected from water with low arsenic content. (Woodard-USGS) W76-13068

#### EPIFAUNA AT JACKSON POINT IN PORT VALDEZ, ALASKA, DECEMBER 1970 THROUGH SEPTEMBER 1972,

Geological Survey, Anchorage, Alaska.  
J. W. Nauman, and D. R. Kernodle.  
Journal of Research of the U.S. Geological Survey, Vol 4, No 3, p 299-304, May-June 1976. 4 fig, 4 tab, 17 ref.

Descriptors: \*Path of pollutants, \*Water quality, \*Alaska, \*Oil industry, \*Benthic fauna, Estuaries, Coasts, Analytical techniques, Biological communities, Sampling, Baseline studies, Pollutant identification.  
Identifiers: \*Epifauna, \*Port Valdez(Alaska).

Epifaunal organisms are abundant in estuaries and coastal waters. Because most epifaunal organisms are immobile and adapted to specific conditions, but restricted in their distribution by physical environmental conditions, they can be used to detect changes in water quality. A biological sampling program at Jackson Point (proposed oil terminal site) in Port Valdez, Alaska, was begun in December 1970. Sixteen artificial substrate samplers (8 multilayer and 8 rock-filled baskets with net liners) were retrieved after 2 to 4 months' exposure. The two sampler types collected approximately the same major groups of organisms; however, the multilayer samplers collected an average of 1.6 times more organisms than the basket samplers. The basket sampler, on the other hand, collected three more species per sample than those of the multilayer samplers. Diversity values were lower during 1972, except for the spring sample. Seasonal diversity varied from a low of 0.36 in the summer of 1972 to a high of 3.99 in the fall of 1971. (Woodard-USGS) W76-13070

#### GEOLOGY AND GROUND-WATER RESOURCES OF UNION COUNTY, NEW JERSEY,

Geological Survey, Trenton, N. J.  
For primary bibliographic entry see Field 4B. W76-13072

#### WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1975.

Geological Survey, Huron, S. Dak.  
For primary bibliographic entry see Field 7C. W76-13073

#### WATER RESOURCES DATA FOR IOWA, WATER YEAR 1975.

Geological Survey, Iowa City, Iowa.  
For primary bibliographic entry see Field 7C. W76-13074

#### WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1975.

Geological Survey, Louisville, Ky.  
For primary bibliographic entry see Field 7C. W76-13075

#### GEOHYDROLOGY OF THE OKLAHOMA PANHANDLE, BEAVER, CIMARRON, AND TEXAS COUNTIES,

Geological Survey, Oklahoma City, Okla.  
For primary bibliographic entry see Field 4B. W76-13081

#### SHIPBOARD OIL-IN-WATER CONTENT MONITOR BASED ON SMALL ANGLE FORWARD LIGHT SCATTERING,

General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.  
For primary bibliographic entry see Field 5G. W76-13094



## Identification Of Pollutants—Group 5A

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. I. CHANGES IN THE PHOTOCHEMICAL ACTIVITIES.**  
Marburg Univ. (West Germany). Botanisches Institut.  
For primary bibliographic entry see Field 5C.  
W76-13109

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. II. CHANGES IN ULTRASTRUCTURE AND PIGMENT COMPOSITION.**  
Marburg Univ. (West Germany). Botanisches Institut.  
For primary bibliographic entry see Field 5C.  
W76-13110

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. III. RECOVERY OF THE PHOTOSYNTHETIC CAPACITY IN AGED CELLS.**  
Marburg Univ. (West Germany). Botanisches Institut.  
For primary bibliographic entry see Field 5C.  
W76-13111

**A SIMPLIFIED METHOD FOR THE BIOLOGICAL ASSESSMENT OF THE QUALITY OF FRESH AND SLIGHTLY BRACKISH WATER.**  
G. N. Dresscher, and H. van der Mark.  
Hydrobiologia, Vol. 48, No. 3, p. 199-201, 1976. 1 fig., 1 tab., 7 ref.

Descriptors: \*Biological communities, \*Analytical techniques, \*Biochemical oxygen demand, Brackish water, Freshwater, Decomposing organic matter, Trophic level, \*Pollutant identification.  
Identifiers: \*Saprobic index.

A simple method is described to biologically assess saprobic water quality a measure of the phase in which the conversion process of biologically decomposable substances takes place. The saprobic degree may be determined by examining the proportion between number of species of single groups of microorganisms; that is, the extent of pollution may manifest itself biologically in numerical proportion between heterotrophic, mixotrophic, and autotrophic organism found at any given moment. The four indicator groups chosen are: A—Ciliate indicating polysaprobity, B—Euglenophyta indicating alpha-mesosaprobity, C—Chlorococcales plus Diatomeae indicating betamesosaprobity, and D—Peridinae plus Chrysophyceae plus Conjugatae indicating oligosaprobity. Ciliata species must be counted immediately in unfixed samples. The others are classified into groups and counted on fixed material under microscopes. A formula is devised to give the saprobic quotient. This method does not require accurate species determinations. Saprobic quotients are compared with the degree of pollution and saprobic phases. This method cannot be used when there is an abundance of a single species which eliminates other species. (Buchanan-Davidson—Wisconsin)  
W76-13115

**QUALITATIVE AND QUANTITATIVE SALMONELLA INVESTIGATIONS AND THEIR HYGIENIC VALUATION IN CONNECTION WITH E. COLI TITRE. DEMONSTRATED WITH EXAMPLES FROM THE COASTAL WATERS OF KIEL BIGHT (WESTERN BALTIC SEA), (IN GERMAN).**  
Kiel Univ. (West Germany). Hygiene Institut.  
H. Gaertner, G. Havemeister, B. Waldvogel, and H. H. Wuthe.

Zentralbl. Bakteriell. Parasitenkd. Infektionskr. Hyg. Erste Abt. Orig. Reihe B Hyg. Praev. Med. 160(3), p. 246-267, 1975.

Descriptors: \*E. coli, Bacteria, Coliforms, Microorganisms, \*Oceans, \*Salmonella, Water pollution sources, Coasts, Testing, Sampling, \*Water analysis, Human diseases, Diseases, Enteric bacteria, Sewage, Wastes.  
Identifiers: \*Baltic Sea, Escherichia-Coli, \*Kiel Bight.

Qualitative salmonella investigations and E. coli titer determinations were carried out in about 4000 water samples from the coastal region of Kiel Bight in 1972 and 1973 and evaluated in connection with epidemiological data. About 100 samples were determined quantitatively by the MPN (most probable number) method and set in relation to the E. coli titer. The significance of positive salmonella findings in relation to the assessment of infection risk and as impurity indicators was investigated. With increasing E. coli contamination the proportion of positive salmonella findings increased (parabolic curve). Salmonella frequencies and the frequency with which the limiting values of the E. coli titer is exceeded run approximately parallel; the frequency of exceeding a limiting value of E. coli titer of 1.0 and the frequency of salmonella (determination in 100 ml) in sewage laden areas largely coincide. The quantitative salmonella investigations (MPN method) showed that up to an E. coli titer of 1.0, extremely low salmonella counts only are found (average 2/100 ml). With an E. coli titer of 0.1 a marked increase is seen. A limiting value of 1.0 is proposed for the E. coli titer in coastal waters. Epidemiological data show that an increased risk of (human) infection cannot be deduced from positive salmonella findings. The value of the information obtained from salmonella findings is small compared with the E. coli titer. Tests for salmonella should be dispensed with in routine water analysis.—Copyright 1976, Biological Abstracts, Inc.  
W76-13140

**METHOD AND DEVICE FOR ASCERTAINING SMALL AMOUNTS OF OIL IN WATER.**  
Salen and Wicander A.B., Sundbyberg (Sweden). (Assignee).  
B. H. Stenstrom.  
U. S. Patent No. 3,964,295, 4 p, 8 fig, 6 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1495, June 22, 1976.

Descriptors: \*Patents, \*Oil pollution, \*Oily water, Water pollution sources, \*Monitoring, Oil wastes, Pollution abatement, Separation techniques, Equipment, \*Pollutant identification.

A method and a device determines the oil content of small amounts of oil in water. The invention is intended to be utilized on board ships, in industries, etc., where large amounts of water are pumped out and where surveillance of the possible presence of oil is necessary and frequently regulated by legislation. A defined amount of water is removed so as to concentrate or enrich the oil and then the oil content is measured. The oil is concentrated by making a predetermined amount of oily water per unit of time pass a determined area of a filter material which absorbs or separates oil. The oil content can be measured photo-electrically by determination of the color change of the oil-absorbing filter material. (Sinha-OEIS)  
W76-13156

**PRESENCE OF INSECTICIDES IN SURFACE WATERS AFTER CONDITIONING TREATMENT, (IN ITALIAN).**  
Camerino Univ. (Italy). Istituto di Igiene.  
For primary bibliographic entry see Field 5F.  
W76-13160

**DETERMINATION OF SODIUM FORM WATER SOFTENER BREAKTHROUGH.**  
Beckman Instruments, Inc., Fullerton, Calif. (Assignee).  
For primary bibliographic entry see Field 5F.  
W76-13161

**OPTIMAL ESTIMATION OF DO, BOD, AND STREAM PARAMETERS USING A DYNAMIC DISCRETE TIME MODEL.**  
Purdue Univ., Lafayette, Ind. School of Electrical Engineering.  
A. J. Koivo, and G. Philips.  
Water Resources Research, Vol. 12, No. 4, p 705-711, August 1976. 9 fig, 10 ref.

Descriptors: \*Water quality control, \*Dissolved oxygen, \*Biochemical oxygen demand, \*Optimization, \*Estimating, \*Simulation analysis, \*Equations, Computers, Water pollution, Streams, Measurement, Filters, Mathematical models, Systems analysis, \*Pollutant identification.  
Identifiers: \*Streeter-Phelps equation.

A modified Streeter-Phelps equation is used as the starting equation to obtain a discrete time mathematical representation for the biological oxygen demand and the dissolved oxygen concentration at discrete spatial locations in polluted stream. It represents an accurate discretization of the original model. The unknown parameters to be estimated are treated as state variables in order to compute their numerical values from noise-corrupted measurements. An optimal estimator is constructed for the estimation of the unknown parameters. Such a model is well-suited to computer applications, such as optimal estimation and control of pollution variables. By using the resulting discrete model, an optimal estimator is constructed to determine DO, BOD, maximum rate of photosynthetic production, and other pollution variables. These optimal estimates minimize the expected value of the sum of the squared estimation errors, given the past and the current measurements. They can be computed by constructing a Kalman filter for the process. A numerical example is presented to illustrate the applicability of the method. (Bell-Cornell)  
W76-13167

**SPECTRAL REFLECTANCE AND RADIANCE CHARACTERISTICS OF WATER POLLUTANTS.**  
Environmental Research Inst., of Michigan, Ann Arbor. Infrared and Optics Div.  
C. T. Wezernak, R. E. Turner, and D. R. Lyzenga.  
Report No. NASA CR-2665, April 1976. 230 p, 25 fig, 160 tab, 58 ref. NASA NAS1-13589.

Descriptors: \*Remote sensing, \*Water pollution, \*Reflectance, Optical properties, Physical properties, Pollutants, Turbidity, Suspended solids, Oil spills, Effluents, Sewage effluents, Industrial wastes, Limnology, Oceanography, Publications, \*Pollutant identification.  
Identifiers: \*Radiance, Visibility.

Spectral reflectance characteristics of water pollutants and water bodies were compiled using the existing literature. Radiance calculations were performed at satellite altitude for selected illumination angles and atmospheric conditions. The work described in this report was limited to the reflective portion of the spectrum between 0.40 micrometer to 1.0 micrometer. Information was included for the following general categories: (1) water bodies, (2) phytoplankton-chlorophyll, (3) suspended solids, (4) oil, (5) municipal effluent, and (6) industrial effluents. The amount of suitable material in the professional literature was found to be very limited. (Sims-ISWS)  
W76-13176

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

**BROADBAND SPECTRAL PHOTOGRAPHY OF THE JAMES RIVER.**  
National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center. W. E. Bressette.

Available from the National Technical Information Service, Springfield, VA 22161 as N75-24068, \$3.50 in paper copy, \$3.00 in microfiche. Report No. NASA TM X-72689, April 1975. 21 p, 3 fig, 2 tab, 11 ref.

**Descriptors:** \*Remote sensing, \*Aerial photography, \*Rivers, \*Virginia, Pollutants, Chlorophyll, Phytoplankton, Photography, Filters, Surveys, Aircraft, \*Pollutant identification.  
**Identifiers:** \*James River(Va), Sunglint, Broadband spectral photography.

On May 28, 1974, a photographic mission from 5.3 km altitude was flown over the James River from Norfolk to Hopewell. During the mission, 252 photographs were exposed over the river. The photographs were divided into four simultaneously exposed groups with each group exposed through a different broadband optical filter. The four filters isolated blue-green, green, yellow, and near-infrared radiation from the water body. The report summarized the mission photography in relation to flight altitude, sunglint, and photographic exposure. It was conc James River from Norfolk to Hopewell, can be considered successful from the mission preplanned that in general, the May 28, 1974, photographic mission from 5.3 km altitude, over the ng standpoint, although final analysis of the radiance in the photographs versus the ground truth data is yet to be accomplished. (Sims-ISWS)  
W76-13180

**THE FEASIBILITY OF OIL-POLLUTION DETECTION AND MONITORING FROM SPACE: EXAMPLES USING ERTS-1 AND SKYLAB DATA.**  
Environmental Research Inst., of Michigan, Ann Arbor. Infrared and Optics Div. G. C. Goldman, and R. Horvath.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A017098, \$4.50 in paper copy, \$3.00 in microfiche. Report No. CG-D-117-75, August 1975. 59 p, 13 fig, 8 tab, 14 ref, 1 append. DOT-CG-24, 063-A.

**Descriptors:** \*Remote sensing, \*Oil spills, \*Oil pollution, Satellites(Artificial), Oceans, Estuaries, Water pollution, Radiation, Monitoring, Pollutants, Data processing, Analytical techniques, \*Pollutant identification.  
**Identifiers:** \*ERTS, \*Skylab.

The purpose of this study was to demonstrate the feasibility of using satellite data as a means of monitoring and detecting oil spills on oceanic and estuarine waters. Four spills, or suspected spills were investigated using photointerpretation and digital-computer techniques on ERTS-1 and SKYLAB data. The results of these investigations indicated that any of these methods might be usable if the spill is large enough to be seen by satellite, if the spill occurs more than a few kilometers off shore, and if the sky and water are relatively clear. In a case in the Atlantic Ocean, the spill was easily seen, but identification of the material was not possible. In the other three cases, the presence of the spills could not be verified at all by computer techniques. ERTS-1 and SKYLAB were not considered operationally appropriate for this type of work because of the former's 18-day overpass frequency, few spectral channels, extended bandwidths, and long information-retrieval time. The latter was considered inappropriate due to its poor data quality, long information-retrieval time, lack of data for all channels, and failure to recover the same area. Monitoring and detecting oil spills could, however, be involved. (Sims-ISWS)  
W76-13181

**STATISTICAL PROBABILITY CHARACTERISTICS OF THE ACCUMULATION OF RADIONUCLIDES IN FRESHWATER PLANTS, (IN RUSSIAN).**  
Ural Science Center, Sverdlovsk (USSR). Inst. of Plant and Animal Ecology. L. I. Piskunov, and B. V. Popov.  
Ekologiya. 5(3), p 90-93, 1974.

**Descriptors:** Statistical methods, \*Probability, \*Radioisotopes, Radioactivity, \*Bioindicators, Absorption, Radioecology, Monitoring, \*Pollutant identification.  
**Identifiers:** Accumulation, Atomic, Fresh, Indicators, Nuclides, Plant, Plants, Pollution, Power, Probability, Radio, Radioactive, Statistical, Water.

The use of hydrobionts as bioindicators of radioactive pollution of water bodies is one of the prospective tasks of applied radioecology. The statistical characteristics of the distribution of the accumulation coefficients of P32, S35, Ca45, Fe59, Co60, Zn65, Rb86, Sr90, Y91, Zr95, Nb95, Ru106, Cs137, Ce144, Ra226 and U233 in some freshwater plants are presented. The data can be used for perfecting radioecological methods in dosimetric monitoring of surface waters, particularly near atomic power plants.--Copyright 1975, Biological Abstracts, Inc.  
W76-13189

**CONCENTRATIONS OF MERCURY, CADMIUM, LEAD AND COPPER IN THE SURROUNDING SEAWATER AND IN SEAWEEDS, UNDARIA PINNATIFIDA AND SARGASSUM FULVUM, FROM SUEYONG BAY IN PUSAN, (IN KOREAN).**  
Pusan Fisheries Coll. (Republic of Korea). C. Y. Kim, and J. H. Won.  
Bull Korean Fish Soc. 7(3), p 169-178, 1974.

**Descriptors:** \*Mercury, \*Cadmium, \*Copper, \*Lead, Bays, \*Sea water, Asia, Heavy metals, Pollutant identification, Water pollution sources.  
**Identifiers:** Sargassum-fulvum, \*Seaweeds, Undaria-pinnatifida, \*Sueyong Bay(So Korea).

Concentrations of Hg, Cd, Pb and Cu were determined in seawater and seaweeds (U. pinnatifida and S. fulvum) from Sueyong Bay in Pusan, South Korea, during the spring and neap tides from Jan-April 1974. The range and mean, respectively, of the heavy metal concentrations in the seawater were: Hg, 0.00-0.39 ppb and 0.16 ppb; Cd, 0.00-0.46 ppb and 0.18 ppb; Pb, 0.00-0.94 ppb and 0.26 ppb; Cu, 0.00-0.86 ppb and 0.25 ppb. The concentrations varied slightly according to the tide. The concentration of Hg, Cd and Pb in U. pinnatifida was almost twice as much as that in S. fulvum; the concentration of Cu in the former was slightly less than that in the latter.--Copyright 1975, Biological Abstracts, Inc.  
W76-13190

**CONTENT OF SOME TRACE ELEMENTS IN MACROPHYTES OF THE VOLGA DELTA, (IN RUSSIAN).**  
Kaspiiskii Nauchno-Issledovatel'skii Institut Rybnogo Khozyaistva, Astrakhan (USSR). V. I. Vorob'ev, and E. I. Afanas'eva.  
Gidrobiol Zh. 9(6), p 75-77, 1973.

**Descriptors:** \*Trace elements, Deltas, Copper, Iron, Aluminum, Maganes, Aquatic plants, Pollutant identification, \*Absorption.  
**Identifiers:** Limnathemum-Nymphoides, \*Macrophytes, \*Phragmites-Communis, Potamogeton-Perfoliatus, Salvinia-Natans, Sparanium-Romusum, \*Volga delta(USSR), \*Reeds.

An investigation of the quantitative content of Cu, Fe, Mn and Al in common reed (Phragmites communis), branched bur-reed (Sparanium ramosum), fringed water-lily (Limnathemum nymphoides), perfoliate pondweed (Potamogeton

perfoliatus) and floating salvinia (Salvinia natans) growing in the Volga delta (USSR) showed that the ability of aquatic plants to concentrate trace elements is determined by the species, age and environmental conditions.--Copyright 1975, Biological Abstracts, Inc.  
W76-13194

### 5B. Sources Of Pollution

**THERMAL RESPONSE OF HEATED STREAMS, SOLUTION BY THE IMPLICIT METHOD.**  
Iowa Univ., Iowa City. Inst. of Hydraulic Research. P. P. Paily, and E. O. Macagno.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-247 382, \$5.00 in paper copy, \$3.00 in microfiche. IIHR Report No. 165, May 1974, 71 p, 10 fig, 23 ref, 2 append.

**Descriptors:** \*Model studies, Mathematical models, \*Thermal pollution, Water pollution effects, Heated water, Discharge(Water), \*Diffusion, Convection, \*Path of pollutants.

A numerical solution is presented of the unsteady convection diffusion equation which can be used for predicting the thermal response of heated rivers during all seasons. The solution which uses a predictor-corrector scheme can predict the transient period as well as the steady state temperature distributions in thermally loaded streams under changing thermal input rates and meteorological conditions. (Chilton-ORNL)  
W76-12685

**HTPGBI: A COMPUTER PROGRAM FOR CALCULATING FROM EXPERIMENTAL DATA THE VARIATION IN HEAT TRANSFER COEFFICIENT ROUND A CYLINDRICAL SURFACE, (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.**  
For primary bibliographic entry see Field 7C.  
W76-12687

**A SURVEY OF NEW YORK SURFACE WATER TEMPERATURES. AERIAL INFRARED SURVEYS OF THERMAL DISCHARGES FROM ELECTRIC GENERATING STATIONS INTO NEW YORK STATE WATERS.**  
New York State Atomic and Space Development Authority, New York.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 998, \$4.50 in paper copy, \$3.00 in microfiche. September 1974. 59 p, 15 fig, 1 tab, 30 ref, 3 append.

**Descriptors:** Water quality, \*Environmental effects, \*Thermal pollution, \*Remote sensing, Monitoring, \*Infrared radiation, \*Hudson River, \*New York, \*Water temperature, \*Path of pollutants, Surveys.

Thermal discharge plumes were measured by aerial infrared sensing techniques at four power stations on the Hudson River: Albany, Danskammer Point, Indian Point and Lovett. Infrared images and related temperature contour maps are included in the report which indicate that the effects observed include tidal currents, local counter-currents, recirculation of discharged water, thermal stratification, and mixing. The capability of the infrared method to fill the current need for quantitative data with broad synoptic coverage is illustrated. (Chilton-ORNL)  
W76-12698

**PRELIMINARY EVALUATION OF THE RADIOLOGICAL QUALITY OF THE WATER ON BIKINI AND ENEU ISLANDS,**  
California Univ., Livermore. Lawrence Livermore Lab.

## Sources Of Pollution—Group 5B

For primary bibliographic entry see Field 5C.  
W76-12701

**STUDIES OF COLUMBIA RIVER WATER QUALITY DEVELOPMENT OF MATHEMATICAL MODELS FOR SEDIMENT AND RADIONUCLIDE TRANSPORT ANALYSIS,**  
Battelle Pacific Northwest Labs., Richland, Wash.  
Y. Onishi, P. A. Johanson, R. G. Baca, and E. L. Hilty.

Available from the National Technical Information Service, Springfield, VA 22161 as BNWL-B-452, \$4.00 in paper copy, \$3.00 in microfiche. Report BNWL-B-452, January 1976, 53 p, 7 fig, 35 ref. E(45-1)-1830.

Descriptors: \*Model studies, \*Mathematical models, Water temperature, \*Sediment transport, Radioisotopes, Radioactive wastes, \*Path of pollutants, \*Columbia River.  
Identifiers: Radionuclide transport.

In a Sediment and Radionuclide Transport Program, quasi-two-dimensional mathematical simulation models for determining radionuclide inventories, their variations with time, and movements of sediments and individual radionuclides in the freshwater region of the Columbia River below Priest Rapids Dam are being applied to the river reach between Priest Rapids and McNary Dams in an initial sensitivity analysis. True two-dimensional finite element models are also being programmed to provide detailed information on sediment and radionuclide behavior in the river. Accuracy and convergence of these numerical codes were tested for one-dimensional steady and unsteady diffusion equations with results indicating high accuracy and good convergence of the models. In a Temperature Analysis Program, river water temperature data for six recording stations was analyzed and catalogued on storage devices. As an accuracy test, the COLHEAT code was applied to the river reach between Grand Coulee and Priest Rapids Dam. The river water temperature predicted by the COLHEAT code agreed quite well with actual field data collected during the same period. (Chilton-ORNL)  
W76-12702

**SAVANNAH RIVER LABORATORY ENVIRONMENTAL TRANSPORT AND EFFECTS RESEARCH, ANNUAL REPORT - FY 1975,**  
Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.

Available from the National Technical Information Service, Springfield, VA 22161 as DP-1412, \$6.75 in paper copy, \$3.00 in microfiche. Report DP-1412, January 1976, 68 p, 26 tab, 52 fig, 100 ref. Crawford, T. V., Compiler. AT(07-2)-1.

Descriptors: \*Environmental effects, \*Path of pollutants, Ecosystems, Model studies, On-site investigations, Biology, South Carolina, Water pollution effects.

Research designed to develop, test, modify, and apply models for calculating transport, dispersion, and effects of various materials moving through environmental systems is presented. The report includes a number of short articles in the areas of atmospheric transport studies, soil and terrestrial biology studies, geologic studies, aquatic transport studies, aquatic biology studies, and dose-to-man studies. The focus of the various studies is on both computer modeling and field experiments. (Chilton-ORNL)  
W76-12714

**THERMAL EFFECTS, (LITERATURE REVIEW),**  
Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 5C.  
W76-12736

**FACTORS CONTROLLING RATES OF METHANE OXIDATION AND THE DISTRIBUTION OF THE METHANE OXIDIZERS IN A SMALL STRATIFIED LAKE,**

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.  
J. W. M. Rudd, and R. D. Hamilton.  
Archives of Hydrobiology, Vol. 75, No. 4, July 1975, p 522-538, 10 fig, 18 ref.

Descriptors: \*Water pollution sources, \*Methane bacteria, Methane, Oxidation, Bacteria, Thermal stratification, Epilimnion, Hypolimnion, Lakes.

Several factors influenced whole lake rates of methane oxidation. Thermal stratification controlled mixing of waters containing methane and oxygen. 95% of the methane oxidation occurred during spring and fall turnover. High oxygen concentrations reduced oxidation rates in the upper part of the water column while rapid rates occurred at oxygen concentrations of less than 1.0 mg/l. During summer stratification high oxygen concentration prevented epilimnetic methane oxidation while anoxia prevented hypolimnetic oxidation. Methane concentration was a control factor only at oxygen concentrations of less than 1.0 mg/l in a narrow lens of activity which occurred in the metalimnion during summer stratification. The bacteria responsible for methane oxidation in this lake appear to be a new strain characterized as being psychrophilic microaerophiles. (Chilton-ORNL)  
W76-12750

**MEASUREMENTS OF PHYSICAL PHENOMENA RELATED TO POWER PLANT WASTE HEAT DISCHARGES: LAKE MICHIGAN, 1973 AND 1974,**

Argonne National Lab., Ill.  
J. V. Tokar, S. M. Zivi, A. A. Frigo, L. S. Van Loon, and D. E. Frye.  
Available from the National Technical Information Service, Springfield, VA 22161, as ANL/WR-75-1. \$10.50 in paper copy, \$3.00 in microfiche. Report ANL/WR-75-1, 352 p, 205 fig 27 ref, append.

Descriptors: \*Water pollution sources, \*Thermal pollution, Nuclear powerplants, \*Lake Michigan, Great Lakes, Limnology, Physical properties, On-site investigations, Discharge(Water), \*Measurement, \*Path of pollutants, \*Pollutant identification.

The report summarizes primary field activities of the Energy and Environmental Systems Division during 1973 and 1974 on Lake Michigan. Overall objectives of the program were to work toward a better understanding and predictive capability of the physical impacts of discharging power-plant waste heat to large temperate lakes. Field site descriptions of Point Beach Nuclear Power Plant, Zion Nuclear Power Station and Donald C. Cook Nuclear Power Plant are given. Maps are presented of areas of surface thermal plumes from single or dual discharges showing that the dual discharge situation produces far field plume areas more than double those of the single discharge situation. Measurements of vertical and horizontal eddy diffusivities and of current velocities at nearshore areas were made. Aerial infrared and boat oriented thermal plume measurement techniques were compared. (See W76-12771 thru W76-12775) (Chilton-ORNL)  
W76-12770

**THERMAL PLUME MAPPING,**

Argonne National Lab., Ill.  
A. A. Frigo, L. S. Van Loon, and C. Tome.  
In: Measurements of Physical Phenomena Related to Power Plant Waste Heat Discharges: Lake Michigan, 1973 and 1974. p 18-163, 119 fig, 5 tab, 2 ref. W-31-109-Eng-38.

Descriptors: \*Water pollution sources, \*Thermal pollution, \*Mapping, Isotherms, On-site investiga-

tions, Instrumentation, Nuclear powerplants, \*Lake Michigan, Great Lakes, Discharge(Water).  
Identifiers: \*Thermal plume mapping.

The plume measurement system employed submerged temperature-sensing thermistors, digitizing and recording electronics, and positioning and depth-sounding instrumentation. Comparisons were made between a limited number of dual and single plumes where salient ambient conditions were matched approximately. Dual plumes had isotherm areas about double those of single plumes where the two jets of the dual discharge had not interacted and behaved as isolated jets. The plume behavior in this regime was weakly dependent on ambient conditions. In some comparisons, farfield isotherm areas were more than double for dual discharge plumes. In all cases, areas of intermediate field isotherms were about the same for dual and single discharges. (See also W76-12770) (Chilton-ORNL)  
W76-12771

**MEASUREMENTS OF EDDY DIFFUSIVITIES IN NEARSHORE REGIONS OF LAKE MICHIGAN,**

Argonne National Lab., Ill.  
S. M. Zivi, D. E. Frye, R. E. Buell, and L. S. Van Loon.  
In: Measurements of Physical Phenomena Related to Power Plant Waste Heat Discharges: Lake Michigan, 1973 and 1974. p 164-210, 21 fig, 4 tab, 15 ref. W-31-109-Eng-38.

Descriptors: \*Thermal pollution, \*Diffusivity, \*Eddies, Discharge(Water), \*Measurement, \*Lake Michigan, Instrumentation, \*Path of pollutants, \*Diffusion.

Measurements of vertical and horizontal eddy diffusivities produced values consistent with open lake values reported in the literature when correlated as a function of a characteristic length scale. Horizontal diffusivities were found to be unperturbed by plume stratification and interfaces within the far field. Vertical diffusivities within the plumes and in the far field were several orders of magnitude smaller than the horizontal values. The measurements provide a range of values for use in theoretical models of thermal plume dispersal where eddy diffusivity is a required input parameter. Refinement of photodensimetric methods and bottle sampling techniques were important steps in developing a field technique and methodology for more rapidly measuring eddy diffusivities. (See also W76-12770) (Chilton-ORNL)  
W76-12772

**A COMPARISON OF AERIAL INFRARED AND BOAT ORIENTED THERMAL PLUME MEASUREMENT TECHNIQUES,**

Argonne National Lab., Ill.  
R. P. Madding, G. J. Marmer, and J. V. Tokar.  
In: Measurements of Physical Phenomena Related to Power Plant Waste Heat Discharges: Lake Michigan, 1973 and 1974. p 211-245, 3 tab, 18 fig, 3 ref. W-31-109-Eng-38.

Descriptors: \*Thermal pollution, \*Measurement, \*Instrumentation, Thermometers, Remote sensing, On-site investigations, Nuclear powerplants, Discharge(Water), \*Lake Michigan, Great Lakes, Infrared radiation.

Near simultaneous thermal plume mapping using the University of Wisconsin's remote aerial infrared scanning system and ANL's in situ boat measurement methods at the Point Beach Power Plant were compared on five occasions. Thermal scanning detects only surface temperatures but the data are acquired rapidly. In situ boat methods require longer times (about one hour to sufficiently define a plume) but temperatures can be measured with depth. Good agreement between the two methods was found with respect to plume features such as contour configurations, areas,



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

centerline temperature decays, and upwelling factors. (See also W76-12770) (Chilton-ORNL) W76-12773

#### NEAR SHORE LAKE CURRENT INVESTIGATIONS,

Argonne National Lab., Ill.

D. E. Frye, L. S. Van Loon, A. A. Frigo, and S. M. Zivi.

In: Measurements of Physical Phenomena Related to Power Plant Waste Heat Discharges: Lake Michigan, 1973 and 1974. p 246-327, 28 fig, 3 tab, 4 ref. W-31-109-Eng-38.

Descriptors: \*Thermal pollution, \*Currents(Water), Shores, Winds, Wind velocity, Velocity, Current meters, Lakes, \*Lake shores, Path of pollutants.

Identifiers: \*Lake currents.

The data showed that nearshore currents to depths of three or more meters are closely correlated to the local wind field with the current speed generally being 1-3% of the wind speed. Time response of these currents was typically a few hours or less. While flow perpendicular to shore did occur and may be significant in terms of mixing a shoreline discharged effluent with offshore water, the currents in the nearshore regions were found to be predominantly in the alongshore directions. Assuming that a bidirectional current describes the nearshore regime, the direction of the flow could be predicted more than 80% of the time from the local wind direction. Bottom friction plays an important role in the inhibition of currents in the nearshore waters. (See also W76-12770) (Chilton-ORNL) W76-12774

#### FIELD OBSERVATION OF THE DYNAMICS OF HEATED DISCHARGE JETS,

Argonne National Lab., Ill.

A. A. Frigo, S. M. Zivi, R. F. King, and E. D. Levinson.

In: Measurements of Physical Phenomena Related to Power Plant Waste Heat Discharges: Lake Michigan, 1973 and 1974. p 328-348, 11 fig, 1 tab, 3 ref. W-31-109-Eng-38.

Descriptors: \*Thermal pollution, \*Heated water, \*Discharge(Water), Hydrodynamics, On-site investigations, Model studies, \*Lake Michigan, Great Lakes, \*Jets, Path of pollutants.

The results of an initial effort to examine the possible dynamical character of heated discharges is discussed. Hydrodynamic and thermal oscillations of measurable amplitude within thermal plumes were noted. Higher frequency oscillations for the Point Beach plant are postulated to be a manifestation of the eddy phenomenon that is active initiating the lateral dispersal of the plume. Such oscillations could cause ramifications in presently used boat techniques for measuring thermal plumes and in regulatory criteria governing heated discharges. (See also W76-12770) (Chilton-ORNL) W76-12775

#### AN ANALYTICAL METHOD FOR DETERMINING HEAT TRANSFER FROM POWER PLANT COOLANT IN THE FLORIDA BOULDER ZONE,

Army Facilities Engineering Support Agency, Fort Belvoir, Va. Research and Technology Div.

M. Greenberg, and A. J. Van den Berg.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A010 432, \$4.00 in paper copy, \$3.00 in microfiche. Report RT-2000, July 1974, 35 p, 9 fig, 3 tab, 5 ref, 3 append.

Descriptors: \*Heat transfer, \*Cooling water, Heated water, Thermodynamics, Powerplants, \*Florida, Geologic formations, Stratigraphy, \*Path of pollutants.

The proposal suggests that a desk study and a field demonstration be conducted to investigate the receptivity and transmissivity of the geological strata underlying south Florida as a means of dissipating heat from power plant coolant at 83 degrees F. The concept of injecting the coolant into this strata, allowing a fresh water bubble to displace sea water and to form and cool for 30 days before being recirculated back to the plant is considered. It was concluded that the average temperature of the bubble would be 68.3 F with approximately 37% of the total water discharged at 61 F and 17% at 83 F. The remaining water would be a mixture at about 73.5 F. (Chilton-ORNL) W76-12777

#### GEOCHEMICAL CONTROLS ON LEAD CONCENTRATIONS IN STREAM WATER AND SEDIMENTS,

Geological Survey, Menlo Park, Calif.

For primary bibliographic entry see Field 5A.

W76-12800

#### REMOTE SENSING STUDY OF MAUMEE RIVER EFFECTS ON LAKE ERIE,

National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.

For primary bibliographic entry see Field 5A.

W76-12819

#### CHEMICAL DYNAMICS OF A POLLUTED WATERSHED, THE MERRIMACK RIVER IN NORTHERN NEW ENGLAND,

Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.

J. Caesar, R. Collier, J. Edmond, F. Frey, and G. Matsoff.

Environmental Science and Technology, Vol. 10, No. 7, p 697-704, July 1976. 4 fig, 10 tab, 21 ref.

Descriptors: \*Model studies, \*Water chemistry, Chemical properties, \*Watersheds(Basins), \*Water quality, \*Massachusetts, \*New England, Analytical techniques, Calcium, Magnesium, Mathematics, Geochemistry, Chemical analysis, Chemistry of precipitation, Runoff, Nutrients, Phosphates, Ions, Seasonal, Suburban areas, Municipal wastes, Agricultural runoff, Dissolved solids.

Identifiers: Chemical dynamics, Polluted watersheds, \*Merrimack River, Northern New England, Flux models, Flow models.

A time series of the major-ion and nutrient composition of the Merrimack River was obtained at several locations on the main channel over a one-year period. Combination of the chemical data with the flow allowed chemical mass fluxes to be calculated and the major chemical inputs modeled. Sodium, calcium, magnesium, and potassium showed significant anthropogenic input (greater than 50%) as well as natural input; phosphate was predominantly anthropogenic while silicate was predominantly natural. It was found that the dependence of concentration on flow can be modeled for some constituents using two input components. The first component had a constant mean composition and steady flux and was identified as groundwater and sewage. The other components had a mean composition which was flow dependent and was identified with runoff events. (Henley-ISWS) W76-12833

#### EXPERIMENTAL STUDY OF TURBULENT STRATIFIED SHEARING FLOW,

McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.

For primary bibliographic entry see Field 2L.

W76-12841

#### TRANSIENT DISPERSION IN UNIFORM POROUS MEDIA FLOW,

Sargent and Lundy, Chicago, Ill.

H. T. Shen.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY6, Proceedings Paper 12202, p 707-716, June 1976. 3 fig, 12 ref, 3 append.

Descriptors: \*Dispersion, \*Unsteady flow, \*Hydraulics, \*Water pollution sources, \*Porous media, Adsorption, Fourier analysis, Aquifers, Groundwater, Analytical techniques, Mathematics, Seepage, Equations, Mathematical studies, \*Path of pollutants.

Identifiers: \*Radioactive decay, \*Transient dispersion, Nonconservative substances, Linear adsorption.

Generalized analytical solutions were derived for transient multidimensional dispersion of nonconservative substances in steady uniform seepage. The finite line or plane boundary source was oriented normal to the flow with time-dependent concentration. Dispersion in longitudinal, lateral, and transverse directions, radioactive decay, and linear adsorption were considered. The solutions derived were valid for convective-dispersion in semi-infinite homogeneous isotropic saturated porous medium. Method of images or Fourier series technique can be used to include the effect of nonflux boundary conditions, when a confined aquifer is to be studied. A two-dimensional example was given for the case when the concentration of the line source varies exponentially with time. The solutions given in this study can be used to study the contamination of groundwater resulting from pollutant sources. (Singh-ISWS) W76-12842

#### COASTAL DISPERSION OF POLLUTANTS,

Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.

R. B. Zeidler.

Journal of the Waterways, Harbors and Coastal Engineering Division, American Society of Civil Engineers, Vol. 102, No. WW2, Proceedings Paper 12121, p 235-254, May 1976. 13 fig, 16 ref, 2 append.

Descriptors: \*Thermal pollution, \*Coastal engineering, \*Dispersion, \*Diffusivity, \*Eddies, Waste water disposal, Heated water, Oceans, Waves(Water), Currents(Water), Analysis, Equations, Turbulence, Mathematical models, Mixing.

Identifiers: \*Eddy diffusivity.

The turbulent eddies of different sites which determine the far field dispersion of pollutants in the marine environment were investigated analytically. For fine turbulence and regular advection, the validity of the local isotropy law was considered and the ways the shore, circulation cells, multiple energy inputs, velocity gradients, waves, and other factors modify this law in the coastal zone were shown. A model of the dispersive effects due to wave-current interactions was proposed, and a formula was given for the spectral eddy diffusivity due to waves and currents. The steady-state diffusion equation was solved for a fairly general case with exponential velocities and eddy diffusivities. By the Fourier transform, this solution was used to include the effect of mesoscale eddies which destroy the regular spreading patterns. A step-by-step procedure was proposed which combined fine turbulence and mesoscale effects. (Adams-ISWS) W76-12843

#### THE EVAPORATION AND DEGRADATION OF N-NITROSO DIMETHYL AMINE IN AQUEOUS SOLUTIONS,

Air Force Civil Engineering Center, Kirtland AFB, N. Mex.

M. G. MacNaughton, and T. B. Stauffer. Available from the National Technical Information Service, Springfield, VA 22161 as ADA-020 922, \$3.50 in paper copy, \$3.00 microfiche. Report AFCEC-TR-75-9, March, 1975. 16 p, 6 fig, 8 ref.

Descriptors: \*Waste water treatment, Geochemistry, Environmental engineering, \*Evaporation, \*Degradation(Decomposition), \*Aqueous solutions, Lagoons, Effluent streams, Public health, Environmental effects, Organic compounds, \*Waste assimilative capacity.  
 Identifiers: \*N-nitroso dimethyl amine, \*Hydrazine compounds.

The fate of N-nitroso dimethyl amine (NDMA) in aqueous solutions and in a 25% caustic waste stream, which is produced in the manufacture of unsymmetrical dimethyl hydrazine (UDMH) was studied. The conditions were intended to approximate those which would effect evaporation, degradation, or both of NDMA in an open lagoon. NDMA in aqueous solutions is easily evaporated and photolyzed. Evaporation accounted for most of the removal in basic solutions, was low for acid solutions, and accounted for half the removal in neutral solutions. The rate of photolysis is higher in acid solutions. In acid and neutral pHs, nitrite severely inhibited the photolysis of NDMA. The evaporation rate was slightly increased by an increase in ionic strength. These results imply that the majority of the NDMA will volatilize from the solutions very rapidly unless the waste is neutralized. If the waste is neutralized and the heat of neutralization does not distill off the NDMA, photolysis will predominate unless nitrite is present. If nitrite were present in this situation, little of the NDMA would leave the lagoon either by volatilization or photolysis. (Snyder-FIRL) W76-12852

**URBAN STORMWATER RUNOFF: DETERMINATION OF VOLUMES AND FLOWRATES,** Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
 V. T. Chow, and B. C. Yen.  
 Report EPA-600/2-76-116, May, 1976. 252 p, 69 fig, 13 tab, 66 ref, 4 append.

Descriptors: \*Analytical techniques, \*Drainage, \*Rainfall, \*Runoff, \*Storm drains, Surface drainage, Computer programs, Environmental engineering, Hydraulics, Hydrology, Mathematical models, Sewers, Urbanization, Water pollution, Water quality.

A depth-duration-frequency analysis method was developed for rainstorms with short return period (high frequency) for urban storm water runoff management and control purposes. The Illinois Urban Storm Runoff method is described, including the development of the model to couple with the Illinois Storm Sewer System Simulation Model and the formulation of a non-reactive water quality model to compute the pollutant concentrations of urban runoff. Selected runoff prediction methods, the rational method, unit hydrograph method, Chicago hydrograph method, British Transport and Road Research Laboratory method, Environmental Protection Agency (EPA) Storm Water Management Model, and the Illinois Urban Storm Runoff method, are evaluated using the recorded hydrographs of four rainstorms in the Oakdale Avenue Drainage Basin in Chicago. The methods are applied to compute the predicted runoff hydrographs, and the results compared with the recorded hydrographs. The most suitable method depends on the objective and accuracy required. The rational method is often satisfactory for a quick, simple approximation of peak runoff rate; for a project involving high accuracy and details of runoff distribution, the Illinois Urban Storm Runoff method is suitable. The EPA Storm Water Management Model may be the alternative if the downstream backwater effects are unimportant. When the unit hydrograph for the drainage area is unavailable, the Transport and Road Research Laboratory method appears preferable to the Chicago and University of Cincinnati methods in most cases. (Snyder-FIRL) W76-12858

**REVIEW AND EVALUATION OF AVAILABLE TECHNIQUES FOR DETERMINING PERSISTENCE AND ROUTES OF DEGRADATION OF CHEMICAL SUBSTANCES IN THE ENVIRONMENT,** Syracuse Univ. Research Corp., N. Y. Life Sciences Div.  
 For primary bibliographic entry see Field 5A. W76-12865

**EFFECT OF THE SOIL MOISTURE REGIME ON THE PASSAGE OF STRONTIUM-90, CESIUM-137 AND CERIUM-144 FROM SOIL INTO SOLUTION, (IN RUSSIAN),** Ural Science Center, Sverdlovsk (USSR). Inst. of Plant and Animal Ecology.  
 N. V. Kulikov, I. V. Molchanova, and E. N. Karavaeva.  
 Ekologiya. 4(4), p 57-62, 1973.

Descriptors: \*Soil moisture, Soils, Path of pollutants, \*Radioisotopes, Distribution, Water pollution sources.  
 Identifiers: \*Cerium-144, \*Cesium-137, \*Strontium-90.

The distribution of 3 radionuclides (Sr90, Cs137 and Ce144), differing in physicochemical properties, in the soil-solution system was studied upon changing the relationship of the solid and liquid phases of the soil within wide limits. Experiments established that with an increase of the soil moisture content, the quantity of Cs137 and Ce144 increases markedly in an equilibrium solution, whereas the content of Sr90 changes less appreciably. Seasonal differences of soil moisture under natural conditions are probably a cause of leveling of the rate of vertical migration of these radionuclides in soil.—Copyright 1975, Biological Abstracts, Inc. W76-12868

**ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES—MIDDLE ATLANTIC BIGHT.**

Environmental Protection Agency, Annapolis, Md. Annapolis Science Center.  
 Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 623, \$6.75 in paper copy, \$3.00 in microfiche. Report EPA-903/9-74-010a, January, 1974. 158 p, 12 fig, 40 tab, 86 ref, 3 append. Lear, D. W., Smith, S. K., and O'Malley, M. L., editors.

Descriptors: \*Pollutant identification, \*Analytical techniques, \*Sludge disposal, \*Waste dumps, \*Oceans, Surveys, Continental shelf, Cruises, \*Atlantic Ocean, Oceanography, Industrial wastes, Acids.  
 Identifiers: Ocean dumping, Oceanographic cruises, Oceanographic surveys, \*Middle Atlantic Bight.

An oceanographic cruise was made in the fall of 1973 to an interim municipal sludge dumpsite and an interim industrial acid waste dumpsite which had been studied on a similar cruise the previous spring. These sites are on the continental shelf in the Middle Atlantic Bight. Hydrographic and bathymetric conditions, major circulation patterns, water quality, sediment composition, heavy metals in sediments and biota, bacteriology, phytoplankton and zooplankton communities, vertebrates, and benthic invertebrates were studied. Temperature and salinity profiles indicated the presence of a pycnocline, but differences between surface and bottom waters were relatively small. Neutral buoyancy seabed drifters left by the previous cruise indicated net bottom water movement toward the west and southwest toward the Delaware, Maryland, and Virginia beaches. Nutrient concentration in waters near the bottom varied seasonally. Elevated nitrate plus nitrite concentrations occurred in bottom waters at the municipal sludge site. Phytoplankton populations were characteristic of mid-temperate coastal com-

munities during fall and winter. Higher mercury, nickel, and manganese concentrations in zooplankton samples than from the previous cruise suggest that certain metals may accumulate in zooplankton. Geographic distribution patterns indicate deposition of heavy metals in sediments as a result of waste disposal. Iron concentrations in sand dollars were less than during the spring cruise. A mechanism is postulated in which accumulation at the pycnocline makes iron less available to the bottom community. (Snyder-FIRL) W76-12875

**HALOGENATED ORGANICS IN TAP WATER: A TOXICOLOGICAL EVALUATION,** Health Effects Research Lab, Cincinnati, Ohio.  
 For primary bibliographic entry see Field 5C. W76-12885

**ORIGIN, CLASSIFICATION AND DISTRIBUTION OF CHEMICALS IN DRINKING WATER WITH AN ASSESSMENT OF THEIR CARCINOGENIC POTENTIAL,** National Cancer Inst., Bethesda, Md.  
 For primary bibliographic entry see Field 5C. W76-12886

**MODELING RESIDUAL CHLORINE LEVELS: CLOSED CYCLE COOLING SYSTEMS,** Industrial Environmental Research Lab., Cincinnati, Ohio.  
 For primary bibliographic entry see Field 5C. W76-12893

**A KINETIC MODEL FOR PREDICTING THE COMPOSITION OF CHLORINATED WATER DISCHARGED FROM POWER PLANT COOLING SYSTEMS,** Oak Ridge National Lab., Tenn.  
 For primary bibliographic entry see Field 5C. W76-12894

**THE CONDUCT OF CERTAIN LONG-LIVED ISOTOPES IN ROCKS IN THE CASE OF THEIR CONTAMINATION WITH NONTECHNICAL EFFLUENTS OF THE ATOMIC ELECTRIC POWER STATIONS (AES), (IN RUSSIAN),** E. I. Orlova, V. A. Smirennaya, and R. A. Chelysheva.  
 Gig Sanit. 38(12), p 65-68, 1973.

Descriptors: \*Radioisotopes, Sorption, \*Rocks, \*Isotope studies, Effluents, \*Cation adsorption, Strontium radioisotopes, Nuclear powerplants, Path of pollutants.  
 Identifiers: \*Cesium-137, \*Cobalt-60, \*Ruthenium-106, \*Strontium-90.

The sorption of isotopes by loose mountainous rocks was studied. Surface-active substances affected the migration of Ru106 and Co60, while Cs137 and Sr90 contained in nontechnical effluents were present in a cation form, which was well sorbed by rocks.—Copyright 1975, Biological Abstracts, Inc. W76-12908

**BEHAVIOR OF CESIUM-137 IN SOILS AND SOIL-PLANT SYSTEMS, (IN POLISH),** Polish Academy of Sciences, Warsaw. Agricultural Isotopes Lab.  
 K. Smierczalska.  
 Postepy Nauk Roln. 20(1), p 89-107, 1973.

Descriptors: \*Radioisotopes, Radioactivity, \*Fallout, \*Soil-water-plant relationships, Metabolism, Europe, Soils, \*Strontium radioisotopes, Sorption.  
 Identifiers: \*Cesium-137, \*Poland.

General comments on the intake of radioactive fallout by plants are presented. Cs-137 and Sr-90 con-

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### Group 5B—Sources Of Pollution

stitute dangerous components of radioactive fallout. Investigations on radioactive pollution are of 2 types: control of Cs-137 and Sr-90 content in soils, waters and precipitation and behavior of various radionuclides in soil-plant-animal-man systems. The average Cs-137 content in Polish soils is given. Assimilability of Cs-137 in the soil-plant system is discussed, including sorption and desorption of Cs-137 in soils. The presence of certain ions and their concentration in the solution-sorption system can modify the reaction of Cs-137 sorption and desorption in soils.—Copyright 1975, Biological Abstracts, Inc W76-12909

**POPULATION BALANCE USE IN DILUTE IMPURITY PROBLEMS**, Iowa State Univ., Ames. Dept. of Nuclear Engineering; and Iowa State Univ., Ames. Dept. of Chemical Engineering. J. D. Stevens, and P. M. Schierholz. Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 337-346, April, 1976. 4 fig, 5 ref, 2 append.

Descriptors: \*Waste water treatment, \*Analytical techniques, \*Chemical precipitation, \*Particle size, \*Nucleation, Growth rates, Flow rates, Equations, Model studies, Calcium compounds, Crystallization, \*Waste dilution. Identifiers: \*Population balance.

The population balance for chemical processes and its applications are introduced. In systems in which precipitation occurs, a population balance permits the characterization of crystal size distribution (CSD) in terms of the birth rate (nucleation), the growth rate, and, if applicable, the death rate. The population balance states that the number of discrete particles must be conserved, and if birth, death, and flow rates are properly represented then all particles can be accounted for. An equation providing a functional relationship between size and population density is derived from the population balance. The technique for obtaining kinetic models for nucleation and growth rate is illustrated. Application of the techniques in a study of the precipitation of calcium carbonate when solutions of calcium sulfate and sodium carbonate are mixed in a continuous crystallizer is described. The analytical approach is useful for processes involving sludge return. The population balance analysis approach is applicable to many environmental situations in which a dilute amount of solute is removed by crystallization. The CSD can be used to derive kinetic relationships used to predict effects of operating changes on the process. (Snyder-FIRL) W76-12914

**CONTRIBUTION ON THE KNOWLEDGE OF THE ORGANIC IN THE COASTAL WATERS OF THE GDR: V. THE VARIABILITY OF THE CHEMICAL OXYGEN CONSUMPTION AT SELECTED STATIONS OF THE WATERS IN THE SHALLOW INLETS TO THE SOUTH OF THE ZINGST PENINSULA DURING THE SYNOPSIS INVESTIGATION IN 1972, (IN GERMAN)**, Rostock Univ. (East Germany). Dept. of Biology. G. Schlunbaum, F. Fischer, and S. Stolle. Wiss Z Univ Rostock Math-Natur-Wiss Reihe 22(10), p 1095-1100, 1973.

Descriptors: \*Organic matter, Coasts, Europe, Inlets, Chemical oxygen demand, \*Sampling. Identifiers: \*Baltic Sea, \*East Germany, Zingst Peninsula(GDR).

Samples taken 4 times daily at 4 stations in the shallow inlets to the S of the Zingst Peninsula (East Germany) were used to determine the degree of fluctuation of organic matter in the water by measuring the chemical O2 consumption. The fluctuation are primarily an expression of changes in the hydrographical situation. The greatest fluctua-

tions are found at the station most affected by the Baltic Sea. Comparisons are made with parameters for cloudiness, yellow substances and depth of visibility.—Copyright 1976, Biological Abstracts, Inc. W76-12916

**FATE OF METALS IN WASTEWATER DISCHARGE TO OCEAN**, CDM, Inc., Pasadena, Calif. N. K. Rohatgi, and K. Y. Chen. Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE3, p 675-685, June, 1976. 6 fig, 4 tab, 9 ref, append.

Descriptors: \*Pollutant identification, \*Waste water(Pollution), \*Discharge(Water), Oceans, \*Deposition(Sediments), Cadmium, Copper, Nickel, Lead, Zinc, \*Path of pollutants, \*California, Bays. Identifiers: \*Santa Monica Bay(Calif).

Experimental results on the settling velocity of sludge solids were used to determine the annual deposition of trace metals on the Santa Monica Bay floor. Trace metal concentrations around the outfall areas are generally lower than the corresponding metal concentrations in the waste effluent particulates. Calculations indicate that approximately 30% of the total solids discharged will be deposited in the sediment and the remainder transported at 0.1 m/sec. About 10% of the total of cadmium, copper, nickel, lead, and zinc will be deposited within 2 km of the outfall. Predictions using experimental data indicate that a significant amount of soluble trace metals will be made available to marine organisms from the discharge of waste water effluent. Their validity can be argued because of the size and complexity of the ocean system. It is certain, however, that only a small portion of trace metals from waste water suspended particulates is represented by the Santa Monica Bay sediment, the remainder being mobilized into the ocean as soluble trace metals. (Snyder-FIRL) W76-12927

**CHEMICAL AND PLANT EXTRACTABILITY OF METALS AND PLANT GROWTH ON SOILS AMENDED WITH SLUDGE**, Department of Agriculture, Ottawa (Ontario). Soil Research Inst. J. D. Gaynor, and R. L. Halstead. Canadian Journal of Soil Science, Vol. 56, No. 1, p 1-8, February, 1976. 3 tab, 28 ref.

Descriptors: \*Pollutant identification, \*Plant growth, \*Loam, \*Clays, \*Sludge, Cadmium, Lead, Copper, Zinc, Absorption.

Sludge was mixed with three soils with widely different properties and incubated, then the mixture was seeded with lettuce and tomato. The soils used were Fox sandy loam (sl), Granby sl, and Rideau clay (c). Sludge addition increased soil pH, total carbon, sodium-bicarbonate extractable phosphorus, cation exchange capacity, and exchangeable calcium. DTPA-extractable cadmium increased 2 to 5 times, lead 2 to 3 times, copper 3 to 7 times, and zinc 7 to 31 times. Incubation for 11 months did not greatly change metal extractability in Granby and Fox sl soils, but extractable zinc, copper lead, and cadmium were reduced in the clay soil following incubation. Raising lettuce reduced the quantity of metal extracted from Fox sl soil and, to a lesser extent, from Rideau c soil, but not from Granby sl soil. Lettuce yields were significantly reduced for the first crop grown on Rideau c and Granby sl soils mixed with fertilizer and sludge compared to yields produced by these soils treated with fertilizer only. All three harvests were reduced with sludge-treated Fox sl soil. The yield reductions for the first two crops were attributed to a salt effect. Raising crops decreased the saturation extract conductivities for all sludge treated soils. Generally, zinc, copper, and lead tis-

sue concentrations in lettuce from Fox and Granby sl soils were significantly increased but total uptake was only increased for zinc. Metal uptake and tissue concentrations for lettuce grown on Rideau c soil treated with sludge and fertilizer were equal to or less than in lettuce from Rideau c soil treated with fertilizer only. Similar trends were observed to a lesser extent with tomatoes. (Snyder-FIRL) W76-12929

**SOLID WASTES AND WATER QUALITY, (LITERATURE REVIEW)**, Environmental Protection Agency, Washington, D. C. Wastewater Research Div. For primary bibliographic entry see Field 5E. W76-12933

**POLLUTANT AEROSOL DEPOSITION INTO SOUTHERN LAKE MICHIGAN**, Illinois State Water Survey, Urbana. Atmospheric Sciences Section. D. F. Gatz. Water, Air, and Soil Pollution, Vol. 5, No. 2, p 239-251, 1975. 1 fig, 6 tab, 33 ref.

Descriptors: \*Water pollution sources, \*Aerosols, \*Lake Michigan, \*Illinois, \*Indiana, Fallout, Air pollution effects, Iron, Lead, Titanium, Particle size, Precipitation(Atmospheric), Estimating equations. Identifiers: Vanadium, Chicago(III).

An important environmental pathway of nutrients and toxic materials into the Great Lakes is via the atmosphere. Estimates of pollutant aerosol input into southern Lake Michigan were made, based on a single calculated emission inventory and estimates of the fraction of emissions that enter the lake. Alternative estimates of urban elemental emissions and their wet and dry deposition in the lake were also made. Emissions were calculated from observed elemental concentration: in urban air. Recently measured wet and dry deposition parameters were used to calculate deposition. The results suggest that atmospheric inputs of pollutant aerosols into the lake are important, representing sizeable fractions of total lake input of iron, lead, titanium, and vanadium. Annual wet and dry depositions are approximately equal. Between 3-15% of the elemental emissions from Chicago and northwest Indiana enter the lake. The fraction of emissions deposited in the lake increases with particle size. The most toxic emissions from increased coal burning near the lake will be largely in relatively small particles, so their deposition to the lake should be smaller than proportional to the extra aerosol mass released. (Buchanan-Davidson-Wisconsin) W76-12935

**LAKE GEORGE SITE SYNTHESIS, 1974-1975**, Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst. For primary bibliographic entry see Field 5C. W76-12937

**COMPARISON OF SINGLE-POINT INJECTIONS IN PIPE FLOW**, Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering. For primary bibliographic entry see Field 8B. W76-12971

**SEDIMENT FLUSHING AFTER DREDGING IN TIDAL BAYS**, Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics. For primary bibliographic entry see Field 8C. W76-12974



## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Sources Of Pollution—Group 5B

#### LOSSES OF NITROGEN IN SURFACE RUNOFF IN THE BLACKLAND PRAIRIE OF TEXAS, Texas Agricultural Experiment Station, College Station.

For primary bibliographic entry see Field 5G.  
W76-12982

#### EFFICIENCY OF NITROGEN, CARBON, AND PHOSPHORUS RETENTION BY SMALL AGRICULTURAL RESERVOIRS, Agricultural Research Service, Oxford, Miss. Sedimentation Lab.

For primary bibliographic entry see Field 4D.  
W76-12983

#### MODEL FOR PREDICTING SIMULTANEOUS MOVEMENT OF NITRATE AND WATER THROUGH A LOAMY SAND,

Wisconsin Univ., Madison. Dept. of Soil Science. W. A. Jury, W. R. Gardner, P. G. Saffigna, and C. B. Tanner.  
Soil Science, Vol. 122, No. 1, p 36-43, July 1976. 8 fig, 16 ref.

Descriptors: \*Mathematical models, \*Soil water movement, \*Dispersion, \*Nitrates, Absorption, Convection, Nitrification, Soil profiles, Water table, Evapotranspiration, Leachate, Drainage, Lysimeters, Moisture content, Infiltration, Equations, Mineralogy.  
Identifiers: \*Mineralization, \*Solute transport.

A simulation model describing nitrate movement through a potato-cropped Plainfield loamy sand was described. Physical processes modeled included dispersion, convection, plant uptake, nitrification, and mineralization. The soil water flow regime was treated approximately by dividing the soil profile into three layers between the surface and the water table and generating water flux and water content profiles by solving a series of mass balance equations which include submodels for evapotranspiration and internal drainage. This information was combined with the solute equation and was solved numerically by the finite element method. Model predictions of nitrate movement often qualitatively agreed with field data when symmetrically comparable profiles were used. Nonuniform infiltration across the hill-furrow unit induced large local variability in solute transport. Predicted and measured nitrate concentrations in lysimeter leachates were in closer agreement when the nonuniform infiltration pattern was incorporated into the model. (Visocky-ISWS)  
W76-12985

#### SOLUTE DISPERSION IN SATURATED SOIL COLUMNS,

Connecticut Agricultural Experiment Station, Storrs. Dept. of Soil and Water. J. L. Starr, and J. Y. Parlange.  
Soil Science, Vol 121, No 6, p 364-372, June 1976. 7 fig, 2 tab, 19 ref.

Descriptors: \*Solute, \*Dispersion, \*Saturated soils, \*Tracers, Flow rates, Diffusion, Laboratory tests, Mathematical models, Stability, Porosity, Graphical analysis, Density, Viscosity, Darcy's law, Hydraulic gradient, Velocity, Particle size, Chlorides.  
Identifiers: \*Chloride-36, \*Soil columns, Fingering model, Glass beads, Concentration, Breakthrough curves.

Chloride-36 traced dispersion in a saturated soil. The amount of dispersion in the vertical soil columns depended upon flow rates and direction and the density difference of the displacing solution. The diffusion model was adequate for the breakthrough curves when molecular diffusion was primarily responsible for dispersion. For the other cases, an explicit finger model was postulated, which provides physical justification for the observed diffusion coefficient for the neutrally

and overstable configuration. In the unstable configuration, the finger model explained why dispersion in a soil is an order of magnitude larger than in glass beads of comparable grain size. (Visocky-ISWS)  
W76-12986

#### EMISSION OF SULFUR FROM LAKE ONTARIO SEDIMENTS,

Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 2J.  
W76-12987

#### THE OCCURRENCE OF ORGANIC MICROPOLLUTANTS IN THE RIVER RHINE AND THE RIVER MAAS IN 1974,

Netherlands Waterworks, Rijswijk. Testing and Research Inst.  
For primary bibliographic entry see Field 5A.  
W76-12988

#### GROUND-WATER QUALITY VARIATION IN

HELPS COUNTY, MISSOURI, Forest Service (USDA), Rolla, Mo. Clark National Forest. C. P. Tryon.  
Ground Water, Vol. 14, No. 4, p 214-223, July-August 1976. 10 fig, 2 tab, 17 ref.

Descriptors: \*Groundwater, \*Water quality, \*Nitrates, \*E.coli, \*Missouri, \*Land use, Pastures, Farm wastes, Agriculture, Karst, Well data, Depth, Correlation analysis, Water pollution, Data collections, Rural areas, Human population.  
Identifiers: \*Phelps County (Mo).

The existing quality of Phelps County, Missouri groundwater in the depth zone most commonly penetrated by nonpublic wells was defined. Information from 675 water wells showed that discrete areas of differing groundwater quality can be identified and mapped. It was learned that the best quality groundwater, as judged by its low nitrate content and coliform bacteria density, is found in areas of relatively little agricultural (pasture and livestock) land use; the poorest quality is found in areas of intensely developed karst and greater agricultural land use; the adverse effect of agricultural land use on groundwater quality is more severe in the intensely developed karst than in the less intensely developed; rural population density and soil association variations have no readily discernible effects on groundwater quality; nitrate content varies seasonally and in response to rainfall, and decreases with increasing well depth; coliform bacteria density is positively correlated with nitrate content. (Visocky-ISWS)  
W76-12991

#### NUTRIENT LOSSES IN SURFACE RUNOFF FROM WINTER SPREAD MANURE,

Wisconsin Univ., Madison, Dept. of Agricultural Engineering. J. C. Converse, G. D. Bubenzer, and W. H. Paulson.  
Transactions of the American Society of Agricultural Engineers, Vol. 19, No. 3, p 517-519, May-June 1976. 1 fig, 6 tab, 10 ref. OWRT B-076-WIS (6).

Descriptors: \*Agricultural runoff, \*Farm wastes, \*Agricultural watersheds, \*Water pollution sources, \*Nutrients, \*Wisconsin, Precipitation, Nitrogen, Phosphorus, Potassium, Alfalfa, Winter.  
Identifiers: Ammonium.

Runoff and nutrient losses from ten alfalfa plots were monitored for a 3 year period. Each plot was 13.2 m by 3.0 m, with slopes ranging from 10 to 12%. Dairy cattle manure was applied to two plots in the fall winter, and spring at the rate of 2.25

kg/sq m (wb). The remaining four plots served as checks. Runoff was measured using tipping buckets and proportionally sampled for nutrient analysis. Annual precipitation for the 3 year period ranged from 1054 to 1088 mm, with 12% as snow. The average annual runoff from the check and the fall, winter, and spring applied manure plots was 136, 73, 104 and 106 mm, respectively. No significant differences were observed in the nutrient losses from the various treatments. Losses for the third year were greater than the previous 2 year period and were attributed to the higher percentage of total runoff that occurred as surface runoff during the 1973-74 winter months as compared to earlier years. (Lardner-ISWS)  
W76-12993

#### VARIATION OF SUSPENDED SEDIMENT LOAD IN THE PALOUSE REGION OF THE NORTHWEST,

For primary bibliographic entry see Field 5G.  
W76-13012

#### FACTORS INFLUENCING THE LOSS OF NITROGEN AND PHOSPHORUS FROM A TRACT OF IRRIGATED LAND,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5G.  
W76-13014

#### ESTABLISHING WATER, NUTRIENT AND TOTAL SOLIDS MASS BUDGETS FOR A GRAVITY-IRRIGATED FARM,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W76-13015

#### SUSPENDED SEDIMENT AND TURBIDITY IN IRRIGATION RETURN FLOWS - A PROTOTYPE STUDY,

Soil Conservation Service, Spokane, Wash. S. Hobson, B. Autry, and B. McGuire.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 12 p, 2 fig. ASAE Paper 75-2547.

Descriptors: \*Suspended solids, \*Suspended load, Sediment discharge, \*Sediment load, Sediment yield, \*Turbidity, \*Surface irrigation, Return flow.

Field measurements of inflow and outflows quantity and quality (suspended sediments and turbidity) were taken from five farm units. Canals, wasteways, and sediment basins were similarly measured. The results provide prototype baseline relationships of the effects of surface irrigation on these two parameters. (Skogerboe-Colorado-State).  
W76-13017

#### DYNAMICS OF SALTS SiO2, R2O3, MNO AND WATER-SOLUBLE ORGANIC MATTER IN UNDERGROUND WATER, (IN RUSSIAN),

Akademiya Nauk SSSR, Novosibirsk. Inst. of Soil Sciences and Agrochemistry. N. I. Bazilevich, T. N. Ryabova, and V. M. Kurachev.  
Izv Sib Otd Akad Nauk SSSR Ser Biol Nauk. 2, p 14-19, 1973.

Descriptors: \*Organic matter, \*Groundwater, \*Salts, Silica, Bicarbonates, Humus, Flocculation, Chemical properties, Manganese.  
Identifiers: Sesquioxides, \*Sodium bicarbonate.

The paper deals with the formation of chemical composition of underground water in the Central Baraba (Central part of the Barabinsk lowland, USSR) depending on flocculation of their water table, direction of transport and soil formation.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

The accumulation of silica, sesquioxides and water-soluble humus in the waters depended on sodium bicarbonate concentration.—Copyright 1974, Biological Abstracts, Inc.  
W76-13043

**TWO-DIMENSIONAL WATER QUALITY MODELING AND WASTE TREATMENT OPTIMIZATION FOR WIDE, SHALLOW RIVERS,** Wisconsin Univ., Madison.  
J. W. Eheart.  
Ph.D. Thesis, 1975, 371 p.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Sewerage, Analytical techniques, \*Biochemical oxygen demand, Water quality standards, \*Mathematical models, Waste treatment, Optimization, Rivers, Model studies, Path of pollutants, \*Dissolved oxygen, Distribution.

A mathematical model was developed for two-dimensional steady-state dissolved oxygen and biochemical oxygen demand (BOD) distribution from the discharge of treated sewage into a wide, shallow river. The results produced by the model were compared with the results of simpler models in a hypothetical case. The implications of the assumptions upon which the simpler models are based are discussed. The model was tested with field data and found to be slightly more accurate than a variation of the model which assumes the channel to be prismatic, and much more accurate than a simpler model assuming a rectangular channel with plug flow. The clearlane was defined as a means to specify standards for ambient water quality. The model and linear programming were used in determining the optimal strategy for sewage treatment for a hypothetical river basin with specified clearlane standards. The dependence of the optimal strategy on the clearlane location was investigated. (Snyder-FIRL)  
W76-13058

**WATER QUALITY MODEL OF A SALT-WEDGE ESTUARY,** Geological Survey, Tacoma, Wash.  
E. A. Prych, and W. L. Hauschild.  
In: Symposium on Modeling Techniques, Volume II; 2nd Annual Symposium of the Waterways, Harbors and Coastal Engineering Division of ASCE (2 Vol.), San Francisco, California, September 3-5, 1975. American Society of Civil Engineers, New York, p 1138-1155, 1975. 8 fig, 9 ref.

Descriptors: \*Model studies, Numerical analysis, Water quality, \*Saline water intrusion, \*Estuaries, Methodology, \*Salinity, \*Water temperature, \*Chlorophyll, \*Dissolved oxygen, Biochemical oxygen demand, Tidal effects, \*Path of pollutants, \*Washington.  
Identifiers: \*Duwamish River estuary(Wash).

A numerical model has been developed and used to calculate salinity, temperature, chlorophyll a (phytoplankton) concentration, biochemical oxygen demand, and dissolved-oxygen concentration in the Duwamish River estuary, Washington. In the model, the estuary is divided vertically into the wedge and the upper layer; the latter is divided into three sublayers. Longitudinally, the estuary is divided into about 35 segments; laterally, the estuary is assumed to be homogeneous. The wedge model is Lagrangian, and the upper-layer model is Eulerian in a coordinate system that moves with the fluid in the wedge. All velocities are computed using conservation-of-volume equations, observed data, and tide stages. The fluid-transport processes modeled are longitudinal advection and dispersion in the wedge; entrainment from the wedge to the upper layer; and longitudinal advection, vertical advection, and vertical diffusion in the upper layer. Biochemical and other physical processes that affect the constituent concentrations are also simulated. The computed concentrations agreed reasonably well with observed data. (See also W76-10415) (Woodard-USGS)  
W76-13063

**OCCURRENCE OF ARSENIC IN THE DRY CREEK BASIN, SONOMA COUNTY, CALIFORNIA,** Geological Survey, Menlo Park, Calif.  
For primary bibliographic entry see Field 5A.  
W76-13068

**EPIFAUNA AT JACKSON POINT IN PORT VALDEZ, ALASKA, DECEMBER 1970 THROUGH SEPTEMBER 1972,** Geological Survey, Anchorage, Alaska.  
For primary bibliographic entry see Field 5A.  
W76-13070

**SUBLACUSTRINE FAN MORPHOLOGY IN LAKE SUPERIOR,** Geological Survey, Menlo Park, Calif.  
W. R. Normark, and F. H. Dickson.  
American Association of Petroleum Geologists Bulletin, Vol 60, No 7, p 1021-1036, July 1976. 10 fig, 1 tab, 30 ref.

Descriptors: \*Sediment distribution, \*Sedimentation rates, \*Tailrace, \*Mine wastes, \*Lake Superior, Model studies, Lake morphology, Sedimentology, Cores, Sampling, Bottom sediments, Minnesota, \*Path of pollutants.

Taconite ore tailings discharged into Lake Superior off Silver Bay, Minnesota, have formed a fan-like feature 20 sq km in area with a morphology and surface-sediment distribution comparable to that of many submarine fans. Two subparallel, leveed fan valleys extend across the upper fan from the base of a virtually unchanneled delta slope. The western fan valley is the deeper of the two, and its western or right-hand (for the downstream direction) levee is higher and wider than its eastern levee, which is shared with the adjacent valley. Although both fan valleys terminate in low-relief suprafans, apparently the larger, western valley has been the primary pathway for sediments transported to the fan. The valleys give way to many small channels on the suprafans, which represent the only appreciable tailings deposition in the mid-fan area. Most of the tailings on the fan are silt-sized deposits that make up the levee complexes of the upper fan. The coarsest sediment (to coarse sand) is confined to the fan-valley floors and suprafan areas. Deposition has been insufficient to form the low half-cone physiography common to middle and lower fan segments on submarine fans. The growth pattern of Reserve fan is comparable to that of submarine fans off the California coast, primarily because of the wide range in grain size of sediment supplied (clay to coarse-pebble grade), and has developed in only 17 years owing to the very high rate of sedimentation, as much as 1.1 m/year on the upper fan. (Woodard-USGS)  
W76-13079

**FACTORS AFFECTING DECLINING WATER LEVELS IN A SEWERED AREA OF NASSAU COUNTY, NEW YORK,** Geological Survey, Albany, N.Y.  
M. S. Garber, and D. J. Sulam.  
Journal of Research of the U S Geological Survey, Vol 4, No 3, p 255-265, May-June 1976. 12 fig, 1 tab, 15 ref.

Descriptors: \*Groundwater, \*Drawdown, \*Analog models, \*Sewerage, \*Water levels, Effects, \*New York, Pumping, Sewers, Sewage treatment, Cesspools, Septic tanks, Groundwater movement, Hydrographs, Mass curves.  
Identifiers: \*Long Island(NY), \*Water level declines.

Double-mass-curve analysis of ground-water levels in Nassau County, Long Island, N.Y., shows that the average-weighted ground-water levels in a 32 sq mi segment of a sewered area declined 11.8 ft relative to an adjacent unsewered area to the east during 1953-72. Electric-analog

model analysis indicates that 4.9 ft of the decline is due to pumping in nearby Queens County, west of the sewered area. Most of the remaining 6.9 ft of the decline is due to sewerage. Streamflow within the sewered area has also declined because of the lowered ground-water levels. (Woodard-USGS)  
W76-13084

**A PRELIMINARY ASSESSMENT OF THE ENVIRONMENTAL VULNERABILITY OF MACHIAS BAY, MAINE TO OIL SUPERTANKERS,** Massachusetts Inst. of Tech., Cambridge.  
For primary bibliographic entry see Field 6G.  
W76-13087

**INPUTS OF PHOSPHORUS FROM PRECIPITATION TO LAKE MICHIGAN,** DePaul Univ., Chicago, Ill.  
T. J. Murphy, and P. V. Doskey.  
Report EPA-600/3-75-005, December 1975. 35 p, 3 fig., 10 tab., 25 ref. R-802647.

Descriptors: \*Phosphorus, \*Precipitation(Atmospheric), \*Lake Michigan, Rain, Phosphates, Hydrogen ion concentration, Snow, Fallout, Air pollution effects, \*Path of pollutants.

Samples of precipitation collected from six locations around Lake Michigan were analyzed for different forms of phosphorus. The atmosphere is presently contributing 1 million kilograms of phosphorus per year or about 18% of the phosphorus budget of the Lake. When the phosphorus removal program on sewage effluents becomes fully implemented in the Lake Michigan basin, the phosphorus contribution to the Lake from particulate matter scavenged by precipitation could increase to about 30% of the total. The average phosphorus concentration in precipitation was about three times the 0.008 mg/l concentration found in the Lake. The phosphorus concentration in precipitation was higher at the south end of the lake. Over 40% of the phosphorus in precipitation was dissolved reactive phosphate thus is immediately available to Lake organism. The amount of dissolved reactive phosphate in precipitation was somewhat dependent on sample pH. Washout ratios for phosphorus by precipitation were determined. Analysis of glacial samples indicated that phosphorus has been a component of precipitation for at least three centuries. Dry fallout also contribute phosphorus to the Lake. Before filtration of samples for determination of dissolved reactive phosphate, pH should be stipulated for equilibrating samples. (Buchanan-Davidson-Wisconsin)  
W76-13112

**QUALITATIVE AND QUANTITATIVE SALMONELLA INVESTIGATIONS AND THEIR HYGIENIC VALUATION IN CONNECTION WITH E. COLI TITRE, DEMONSTRATED WITH EXAMPLES FROM THE COASTAL WATERS OF KIEL BIGHT (WESTERN BALTIC SEA), (IN GERMAN),** Kiel Univ. (West Germany). Hygiene Institut.  
For primary bibliographic entry see Field 5A.  
W76-13140

**DESCRIBING VARIANCE WITH A SIMPLE WATER QUALITY MODEL AND HYPOTHETICAL SAMPLING PROGRAMS,** Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
S. F. Moore, G. C. Dandy, and R. J. DeLucia.  
Water Resources Research, Vol 12, No 4, p 795-804, August 1976. 7 fig, 2 tab, 18 ref.

Descriptors: \*Water quality control, \*Sampling, \*Decision making, Evaluation, Time, History, Data collections, Estimating, Mathematical models, Simulation analysis, Costs, Impoundments, Eutrophication, Equations, Systems analysis, \*Risks.

Identifiers: Errors, Filtering theory.

An explicit treatment of the uncertainty in the state of water quality in a body of water can provide a quantitative basis for sampling decisions. Filtering theory, an extension of Bayesian analysis to dynamic systems, is used to obtain an algorithm which describes the time history of variance (uncertainty) in estimates of water quality parameters. Uncertainties arising from measurement errors, incompleteness of data, and random fluctuations exhibited by natural phenomena are taken into account. Sampling design capabilities are illustrated in an evaluation of sampling frequencies for the National Eutrophication Survey. The adequacy of any sampling program is dependent on the available prior data and on the value associated with reductions in uncertainty. (Bell-Cornell)

W76-13162

**DEVELOPMENT AND APPLICATION OF A WATER RESOURCE ALLOCATION MODEL,** Engineering-Science, Inc., Berkeley, Calif. For primary bibliographic entry see Field 5G. W76-13168

**CONCENTRATIONS OF MERCURY, CADMIUM, LEAD AND COPPER IN THE SURROUNDING SEAWATER AND IN SEAWEEDES, UNDAIRIA PINNATIFIDA AND SARGASSUM FULVELLUM, FROM SUEYONG BAY IN PUSAN, (IN KOREAN),** Pusan Fisheries Coll. (Republic of Korea). For primary bibliographic entry see Field 5A. W76-13190

**CHARACTERISTICS OF BOATS AS SOURCES OF SEA POLLUTION, (IN RUSSIAN),** Scientific Research Inst. of Water Transport Hygiene, Moscow (USSR). D. N. Loranskii, B. M. Raskin, and N. N. Alfimov. Gig Sanit. 1, p 74-76, 1974.

Descriptors: \*Oil pollution, Oil spills, Oil wastes, \*Water pollution sources, \*Waste disposal, Coasts, \*Waste treatment, Sea water, Ships.

Most sea pollution is caused by tankers discharging oil-containing ballast waters in ports. Washing of tankers and boat accidents are other sources of sea pollution. Waste disposal from moored boats in harbors leads to pollution of the coastal waters. Installations, devices and waste treatment methods to prevent sea water pollution by boats are presented.—Copyright 1975, Biological Abstracts, Inc. W76-13191

**AN ATTEMPT TO EVALUATE THE STATE OF HEALTH OF FISH FROM THE LYNA AND WALSAZ RIVERS IN CONNECTION TO THEIR POLLUTION, (IN POLISH),** For primary bibliographic entry see Field 5C. W76-13192

**QUANTITATIVE DYNAMICS OF BACTERIA IN THE KREMENCHUG RESERVOIR, (IN RUSSIAN),** Akademiya Nauk URSR, Kiev. Institut Hidrobiologii. For primary bibliographic entry see Field 5C. W76-13195

**REMOVAL OF TRACE ELEMENTS BY THE DNESTR RIVER, (IN RUSSIAN),** For primary bibliographic entry see Field 5G. W76-13197

## 5C. Effects Of Pollution

**SOME PHYSIOLOGICAL EFFECTS OF NEAR-MAXIMUM GROWTH TEMPERATURES ON AN OBLIGATELY PSYCHROPHILIC MARINE BACTERIUM,** Oregon State Univ., Corvallis. Dept. of Microbiology. G. G. Geesey, and R. Y. Morita. Canadian Journal of Microbiology, Vol. 21, No. 6, 1975, p 811-818, 8 fig, 2 tab, 12 ref. NSF Ga 38583X.

Descriptors: \*Physiological ecology, Animal physiology, Temperature, Thermal stress, Bacteria, Environmental effects.

Ant-300 is an obligate psychrophile, having a temperature optimum for growth of 7°C, and failing to grow above 13°C. Heat inactivation of the bacterium was investigated in terms of glucose uptake, the oxidation of glucose to carbon dioxide, and permeability control. Upon initiation of heat shock, carbon dioxide evolution from oxidation of glucose increased but as duration of shock continued, a decrease of glucose oxidation occurred. Data indicated that heat inactivation of cellular processes occurs at temperatures as low as 13°C. It was concluded that it was impossible to determine from these studies whether the time and temperature-dependent decrease in glucose accumulation was caused by heat-induced restrictions on the transport system mediating glucose uptake, or by loss of intracellular glucose through leakage. Data suggested that the cell envelope was damaged. (Chilton-ORNL) W76-12681

**AN ASSESSMENT OF NUCLEAR POWER PLANT WASTE HEAT UTILIZATION FOR FRESHWATER FISH FARMING,** Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment. J. E. Guthrie, D. R. Prowse, and D. P. Scott. AECL-4924, May 1975, 47 p, 8 fig, 1 tab, 19 ref, append.

Descriptors: \*Aquaculture, Effluents, \*Nuclear powerplants, \*Fish farming, \*Heated water, Cooling water, \*Thermal pollution.

The feasibility and economic potential of aquaculture are investigated. The cooling water from nuclear power stations of one 600MW(e) reactor are reported to be adequate to achieve an annual production of at least 12 Gg of rainbow trout. A pilot plant is described which is designed to demonstrate public acceptance of product, continuous rather than batch production, control of fish diseases, suitability of alternative fish feeds, and rearing procedures for aquatic species other than rainbow trout. (Chilton-ORNL) W76-12682

**THERMAL RESPONSE OF HEATED STREAMS, SOLUTION BY THE IMPLICIT METHOD,** Iowa Univ., Iowa City. Inst. of Hydraulic Research. For primary bibliographic entry see Field 5B. W76-12685

**SURVEY FOR RADIOACTIVITY IN A SWAMP,** Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Plant. J. E. Johnson. Available from the National Technical Information Service, Springfield, VA 22161 as DPSPU 75-30-8, \$3.50 in paper copy, \$3.00 in microfiche. DPSPU 75-30-8, Paper for presentation at the Third Environmental Protection Conference, September 23-25, 1975, held in Chicago, 10 p, 4 fig, 5 tab. AT(07)-2-1.

Descriptors: \*Environmental effects, \*Radioactivity, \*Monitoring, \*Swamps, South Carolina, Surveys, Pollutant identification. Identifiers: Savannah River Plant(SC).

During periods of high water, Savannah River Plant effluents are diverted through a swamp and across the downstream plant boundary. An estimated 25 curies of cesium 137 and less than 1 curie of cobalt 60 have been deposited in an offsite location. Aerial and ground surveys indicated dose rates generally below 60 microR/hr. with a maximum of 120 microR/hr. Soil samples contained Cs137 ranging from less than 1 to 525 pCi/g in the top 7.5 cm. Vegetation contained from 1 to 235 pCi/g and wildlife from less than 1 to 15 pCi/g in edible tissue. Monitoring to date shows that the swamp sediments are immobile. No restrictions on use of the swamp are warranted. No increases in radioactivity are expected to occur but the swamp will be monitored annually to evaluate possible redistribution of the Cs137. (Chilton-ORNL) W76-12689

**THERMAL EFFECTS ON AQUATIC ORGANISMS, ANNOTATED BIBLIOGRAPHY OF THE 1974 LITERATURE,** Oak Ridge National Lab., Tenn. Bibliography Report ORNL-EIS-75-28, 168 p, June 1975. Edited and Compiled by Coutant, C. C., Talmadge, S. S., Carrier, R. R. F., and Collier, B. N. W-7405-eng-26.

Descriptors: Documentation, \*Bibliographies, \*Thermal pollution, \*Thermal stress, Temperature, \*Water pollution effects, Publication, Water temperature.

This bibliography is the fourth in a series on the subject of thermal effects. It contains 570 references which are arranged alphabetically by first author. Indexes are provided for author, keywords, subject category, geographic location, taxon, and title (alphabetical listing of keyword-in-context of the nontrivial words in the title). Documents in which temperature is a variable or important to the experiment are included. Heat sterilization studies, laboratory studies that do not relate to the environment, and seasonal field studies with no specific mention of temperature are not included. (Chilton-ORNL) W76-12692

**EFFECTS OF 1973 RIVER FLOOD WATERS ON BROWN SHRIMP IN LOUISIANA ESTUARIES,** Louisiana Wildlife and Fisheries Commission, New Orleans. Div. of Oysters, Water Bottoms and Seafoods. C. J. White. Technical Bulletin No. 16, August 1975, 24 p, 18 fig, 26 ref.

Descriptors: \*Environmental effects, \*Floods, \*Shrimp, \*Estuaries, \*Louisiana, Hydrology, Temperature, Salinity, Growth, Dispersion, Mortality.

Adverse hydrological conditions occurred along the Louisiana coast during March, April, and May of 1973 and were the result of record flood discharges, primarily from the Mississippi and Atchafalaya river systems. Local flooding existed on the many smaller rivers confluencing on the Louisiana coast to further compound the problem. Shrimp conditions that existed prior to the flood crisis were comparable to preceding years in areas of primary production. Hydrological conditions (salinity and temperature) that prevailed following the post larvae in 1973 were not conducive to brown shrimp growth, dispersal, and survival. This resulted in a considerable loss to the industry and the total impact should be felt for some time. (Chilton-ORNL) W76-12693



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

**CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING AS LOW AS PRACTICABLE GUIDES-FABRICATION OF LIGHT-WATER REACTOR FUELS CONTAINING PLUTONIUM, Oak Ridge National Lab., Tenn.**

W. S. Groinier, R. E. Blanco, R. C. Dahlman, B. C. Finney, and A. H. Kibbey.  
Available from the National Technical Information Service, Springfield, VA 22161, as ORNL-TM-4904, \$6.75 in paper copy, \$3.00 in microfiche. Report ORNL-TM-4904, May 1975, 140 p, 19 fig, 34 fig, 74 ref, append. W-7405-eng-26.

**Descriptors:** \*Cost-benefit analysis, \*Nuclear wastes, Model studies, Nuclear engineering, \*Radioactivity, Plutonium, \*Waste treatment, Cost analysis.  
**Identifiers:** Fuel fabrication plants, Light water reactors.

This cost-benefit study uses a base case model plant which is representative of current plant technology and has an annual capacity of 300 metric tons of uranium and plutonium (as metal). Three conceptual gaseous radwaste treatment cases and their corresponding flowsheets were prepared for treating the wastes from the model plant. The base case represents the lowest cost and current practice. In each of the succeeding cases, gaseous radwaste treatment was added to accomplish specific objectives. The cost for the added waste treatment operations and the corresponding dose commitment are calculated for each case. Methodology for estimating the costs and the radiological doses, detailed calculation, and tabulations are presented. (Chilton-ORNL)  
W76-12694

**ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION, VOLUME 3. CHEMISTRY OF LAKE MICHIGAN, Wisconsin Univ., Madison. Water Chemistry Lab. M. S. Torrey.**  
Report ANL/ES-40, Vol. 3, May 1976, 418 p, 115 fig, 81 tab, 3 append, 431 ref. W-31-109-Eng-38.

**Descriptors:** \*Data collections, \*Chemistry, \*Lake Michigan, Water quality, Effluents, Chemicals, Sediments, Water quality standards, Lake sediments, Lakes, Lake sediments.

Summaries are presented chemical data collected in Lake Michigan and its two major embayments, Green Bay and Grand Traverse Bay, over the past twenty years. Concentrations of chemicals found in offshore waters which represent water quality least affected by man are compared with levels found in nearshore waters which in many cases have been appreciably altered by human activities. Concentrations of nutrients and toxicants are surveyed and compared with levels currently judged acceptable for the maintenance of human health and the propagation of desirable aquatic organisms. Sedimentary behavior of chemicals and external factors modifying the chemistry of the lake (erosion, weathering, municipal and industrial effluents, dry fallout and precipitation, and nonpoint surface and subsurface inputs) are considered. (Chilton-ORNL)  
W76-12695

**PRELIMINARY EVALUATION OF THE RADIOLOGICAL QUALITY OF THE WATER ON BIKINI AND ENEU ISLANDS, California Univ., Livermore. Lawrence Livermore Lab. V. E. Noshkin, K. M. Wong, R. J. Eagle, and G. Brown.**  
Available from the National Technical Information Service, Springfield, VA 22161 as UCRL-51971, \$3.50 in paper copy, \$3.00 in microfiche. Report UCRL-51971, December 1975, 19 p, 5 fig, 6 tab, 12 ref. W-7405-Eng-48.

**Descriptors:** \*Water quality, \*Path of pollutants, Water quality standards, Radiosotopes, Water wells, Groundwater, Water pollution.  
**Identifiers:** Bikini Islands.

The objective of the survey reported upon was to evaluate the potential radiation doses that could be received by persons returning to the islands of the Bikini Atoll. Data was obtained from water samples collected at old and new well sites on both Bikini and Eneu Islands and from the cistern water on Bikini Island. The radiological quality of the groundwater varied from one location to another on both islands. Assessment of the chemical quality of the ground water showed that, by U. S. Public Health Standards, the ground water at two stations on Eneu and one station on Bikini would be considered brackish; at one station on Eneu and two on Bikini it appeared to be potable; and at one station on Eneu and three on Bikini the water was chemically acceptable for drinking, household and agriculture purposes if the taste could be tolerated. The cistern water on Bikini Island was both chemically and radiologically acceptable as drinking water. On Eneu Island, the radionuclide concentrations varied among the ground water samples. Therefore, a complete dose assessment of all pathways must be completed before this water is recommended as usable. (Chilton-ORNL)  
W76-12701

**STUDIES OF COLUMBIA RIVER WATER QUALITY DEVELOPMENT OF MATHEMATICAL MODELS FOR SEDIMENT AND RADIONUCLIDE TRANSPORT ANALYSIS, Battelle Pacific Northwest Labs., Richland, Wash. For primary bibliographic entry see Field 5B.**  
W76-12702

**THERMAL EFFECTS, (LITERATURE REVIEW), Oak Ridge National Lab., Tenn. C. C. Coutant, and S. S. Talmage.**  
Journal Water Pollution Control Federation, Vol. 48, No. 6, June 1976, p 1489-1544, 8 tab, 605 ref.

**Descriptors:** \*Reviews, \*Environmental effects, \*Thermal pollution, Thermal stress, Thermal water, Aquatic life, \*Bibliographies, Water pollution effects.

The 1975 literature pertaining to thermal effects on aquatic organisms is reviewed. Areas given attention include site studies, effects on growth and production, community responses, reproduction, development, morphology, distribution, thermal tolerance, oxygen metabolism, growth, feeding activity and digestion, temperature stresses, preferred temperature, predator-prey relations, decomposers, diseases and parasites, and beneficial uses. (Chilton-ORNL)  
W76-12703

**ON THE COEXISTENCE OF SCAVENGERS ON SHALLOW SANDY, BOTTOMS IN GULLMAR FJORD (SWEDEN), ADAPTATIONS TO SUBSTRATUM, TEMPERATURE, AND SALINITY, Uppsala Univ. (Sweden). Inst. of Zoology. S. Eriksson, S. Evans, and B. Tallmark.**  
ZOON, Vol. 3, 1975, p 65-70, 4 tab, 1 fig, 11 ref.

**Descriptors:** \*Ecology, \*Scavengers, Niches, Adaptation, \*Temperature, \*Salinity, Sands, Resistance, Bottom sediments, Fjords.  
**Identifiers:** \*Substratum, Gullmar Fjord (Sweden).

The adaptations of dominant scavengers to substratum, temperature, and salinity were investigated in the laboratory. Responses to substratum were studied in two-choice experiments and responses to temperature and salinity in tolerance experiments. Crangon vulgaris and Nannasteria reticulata principally chose soft substratum, Pagurus bernhardus and Asterias rubens L. preferred hard substratum with Carcinus

maenas being intermediary between the two groups in preference. Temperature tolerances (100% survival) were ranked in the following order: Nannasteria reticulata (0-33 degrees C), Carcinus maenas (0-33C), Crangon vulgaris (0-28C), Pagurus bernhardus (0-24C), and Asterias rubens (0-22C). Salinity tolerances were ranked in the following decreasing order: Carcinus maenas (5-54%), Crangon vulgaris (3-45%), N. reticulata (0-45%), P. bernhardus (14-43%), and A. rubens (13-38%). The species showing the largest over-capacity for this biotope were those preferring shallow bottoms and soft substratum. (Chilton-ORNL)  
W76-12704

**PHYSIOLOGICAL ECOLOGY OF FOUR POLYSIPHONIA SPECIES (RHODOPHYTA, CERAMIALES), New Hampshire Univ., Durham. Jackson Estuarine Lab.; and New Hampshire Univ., Durham. Dept. of Botany. R. A. Fralick, and A. C. Mathieson.**  
Marine Biology, Vol. 29, 1975, p 29-36, 7 fig, 2 tab, 34 ref.

**Descriptors:** \*Environmental effects, \*Distribution patterns, \*Physiological ecology, Photosynthesis, Respiration, \*Marine algae, Light, Temperature, Salinity, \*Rhodophyta.  
**Identifiers:** Ceramiales.

The effect of light, temperature and salinity upon photosynthesis and respiration of four marine red algae were investigated. Cold water plants (active photosynthesis as low as 5 degrees C with peak photosynthesis at 21-24 C) showed signs of thermal stress at temperatures of 25 C and a narrow tolerance to low salinities at high temperature temperatures. Plants with warm water affinities (little or no photosynthesis below 10 degrees C and with peak photosynthesis at 27-30 C) showed signs of thermal stress at 30 C and had a wider tolerance to low salinities. Light optima for the four species, in respect to their habitats, was comparable to other intertidal and subtidal red algae. Horizontal distribution was primarily governed by their tolerances to high temperatures and low salinities. Good correspondence was found between natural distribution patterns and manometric results. (Chilton-ORNL)  
W76-12705

**EFFECT OF WATER TEMPERATURE ON THE PREDATORY EFFICIENCY OF GAMBUSIA AFFINIS, Bangalore Univ. (India). Dept. of Zoology. S. R. Reddy.**  
Experientia, Vol. 31, No. 7, 1975, p 801-802, 1 fig, 1 tab, 11 ref.

**Descriptors:** \*Environmental effects, \*Water temperature, \*Fish behavior, Laboratory tests, Fish, Feeding rates, \*Predation, \*Livebearers, Thermal pollution.

The magnitude of reduction in predatory efficiency depended upon sex and the physiological status of the fish. Predation increased with increasing temperature (20, 25, or 30C) but was significant only for gestating females. Results indicate that C. affinis does respond thermostatically, and water temperature appears to be the overriding stimulus that regulates the predatory efficiency. (Chilton-ORNL)  
W76-12709

**EFFECTS OF TEMPERATURE ON OIL REFINERY WASTE TOXICITY, Utah State Univ., Logan. Dept. of Civil and Environmental Engineering. J. H. Reynolds, E. J. Middlebrooks, D. B. Porcella, and W. J. Grenney.**  
Journal Water Pollution Control Federation, Vol. 47, No. 11, November 1975, p 2674-2693, 73 ref.

Descriptors: \*Industrial wastes, \*Laboratory tests, \*Oil wastes, Oil pollution, \*Algae, Phenols, Model studies, \*Toxicity, Thermal pollution, Water pollution effects.  
Identifiers: \*Selenastrum capricornutum.

A continuous flow kinetic model was developed to describe and predict the effects of temperature on the toxicity of a specific oil refinery waste to the alga *Selenastrum capricornutum*. The model was based on enzyme inhibition kinetics and was developed by using semicontinuous and continuous flow algal cultures grown at temperatures between 20 and 33 C. Phenol was the controlling toxicant. Phenol was more toxic to *Selenastrum capricornutum* at 24 C than at either 20 or 28 C. Time increases the toxicity of phenol to the organism. Oil refinery waste was approximately 10 times more toxic than pure phenol to *S. capricornutum*. (Chilton-ORNL)  
W76-12711

DEVELOPMENT OF A STUDY PLAN FOR DEFINITION OF PCBs USAGE, WASTES, AND POTENTIAL SUBSTITUTION IN THE INVESTMENT CASTING INDUSTRY.  
Versar, Inc., Springfield, Va.  
For primary bibliographic entry see Field 5G.  
W76-12713

SAVANNAH RIVER LABORATORY ENVIRONMENTAL TRANSPORT AND EFFECTS RESEARCH, ANNUAL REPORT - FY 1975, Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.  
For primary bibliographic entry see Field 5B.  
W76-12714

CADMIUM CONCENTRATIONS IN ROCK SCALLOPS IN COMPARISON WITH SOME OTHER SPECIES.  
California Univ., Livermore. Lawrence Livermore Lab.  
G. M. Vattuone, K. S. Griggs, D. R. McIntyre, J. L. Littlepage, and F. L. Harrison.  
Available from the National Technical Information Service, Springfield, VA 22161 as UCRL-52022, \$3.50 in paper copy, \$3.00 in microfiche. Report UCRL-52022, February 1976, 11 p, 5 tab, 1 fig, 24 ref. W-7405-Eng-48.

Descriptors: \*Environmental effects, \*Cadmium, Path of pollutants, Mussels, Shellfish, California.  
Identifiers: \*Rock scallops, Santa Barbara (Calif), Anacapa Islands (Calif).

Specimens of rock scallops and mussels were collected at Santa Barbara and Anacapa Islands. The species were compared for cadmium concentrations. Data from the collections showed that concentrations in the total soft tissue were 16 times higher in the rock scallop than in the mussel. Detailed analysis showed the highest concentration to be in the digestive gland and stomach and the lowest concentration in the adductor muscle. The results were confirmed by tracer experiments with Cd 109. (Chilton-ORNL)  
W76-12715

RELATION OF WATER TEMPERATURE TO CERATOMYXOSIS IN RAINBOW TROUT (*SALMO GAIRDNERI*) AND COHO SALMON (*ONCORHYNCHUS KISUTCH*).  
Oregon State Univ., Corvallis. Dept. of Microbiology.  
L. R. Udey, J. L. Fryer, and K. S. Pilcher.  
Journal of the Fisheries Research Board of Canada, Vol. 32, No. 9, 1975, p 1545-1551, 2 tab, 1 fig, 9 ref.

Descriptors: \*Environmental effects, \*Parasitism, \*Fish parasites, Fish, Temperature, \*Rainbow trout, Salmon, Mortality.  
Identifiers: \*Coho salmon.

Juvenile rainbow trout and coho salmon were exposed to infection with *Ceratomyxosis shasta* and then groups of the fish were held at various temperature levels increasing from 3.0 to 23.3C by 2.8C increments. Rainbow trout deaths did not occur at 3.9C but at the other experimental temperatures mortality averaged about 80% over a period of 237 days. No coho salmon deaths occurred at 3.9 or 6.7C but at other temperatures mortality increased progressively from 2% at 9.4C to 22% at 15.0C and 84% at 20.5C. The geometric-mean time from exposure to death in rainbow trout was a function of temperature increasing from 14 days at 23.3C to 155 days at 6.7C. The geometric-mean time from exposure to death of coho salmon increased from 12.5 days at 23.3C to 146 days at 9.4C. (Chilton-ORNL)  
W76-12716

SUMMER DISTRIBUTION OF FISH SPECIES IN THE VICINITY OF A THERMAL DISCHARGE NEW RIVER, VIRGINIA.  
Virginia Polytechnic Inst. and State Univ., Blacksburg.  
J. R. Stauffer, Jr., K. L. Dickson, J. Cairns, Jr., W. F. Calhoun, and M. T. Masnik.  
Archives of Hydrobiology, Vol. 76, No. 3, November 1975, p 287-301, 6 fig, 2 tab, 27 ref.

Descriptors: \*Distribution patterns, \*Fish, \*Thermal pollution, Temperature, On-site investigations, Environmental effects, Water pollution effects, \*Virginia.  
Identifiers: \*New River (Va).

By applying multivariate screening techniques to comprehensive in situ fish data the influence of temperature on fish distribution was evaluated. The results of the study indicated that temperature was extremely important to distributional patterns. The stoneroller, northern hog sucker, and rosyside shiner all avoided temperatures above 80 F. The channel catfish demonstrated a preference for temperature exceeding 91F, while the distribution of the spotfin shiner appeared to be unaffected by temperature. (Chilton-ORNL)  
W76-12717

SEASONAL ABUNDANCE AND DISTRIBUTION OF MARINE FISHES AT A HOT-WATER DISCHARGE IN GALVESTON BAY, TEXAS.  
Texas A and M Univ., College Station. Dept. of Wildlife Science.  
B. J. Gallaway, and K. Strawn.  
Contributions in Marine Science, Vol. 18, 1974, p 71-137, 44 tab, 11 fig, 38 ref.

Descriptors: \*Water pollution effects, \*Thermal pollution, \*Fish, Seasonal, \*Distribution, Temperature, Effluents, \*Texas, \*Marine fish, Bays.  
Identifiers: \*Galveston Bay (Tex).

Biological and hydrological data were collected monthly from January 1968-December 1969 at 17 stations in the discharge area of the P. H. Robinson Generating Station. Discharge waters were usually about 8C warmer on the surface and 7.4C warmer on the bottom than bay water temperatures. Most species of fish appeared attracted to the effluent except during periods when temperatures were too hot. General reaction to this condition was avoidance until the effluent cooled. The lowest elevated temperature a species was observed to avoid was 30 C by Gulf menhaden. Cooling of effluent waters is not recommended for periods other than summer. The presence of warm water during winter is normally beneficial. It was concluded that with proper siting and design, power plants could be used as tools to enhance non-productive areas of Texas estuaries as nursery grounds. (Chilton-ORNL)  
W76-12718

INFLUENCE OF TEMPERATURE ON SEXUAL DIFFERENTIATION IN CRUSTACEA,

(TEMPERATURE ET DIFFERENCIATION SEXUELLE CHEZ LES CRUSTACES),  
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Laboratoire de Genetique Evolutive et de Biometrie; and Centre National de la Recherche Scientifique, St. Cloud (France). Laboratoire de Sciences Naturelles.  
T. Ginsburger-Vogel.  
Bulletin de la Societe Zoologique de France, Vol. 100, No. 1, 1975, p 95-115, 3 fig, 4 tab, 80 ref.

Descriptors: Environmental effects, \*Temperature, Biology, Gonads, \*Crustaceans.  
Identifiers: \*Sexual differentiation (Crustaceans).

Temperature influence on sexual differentiation was investigated on cyclical parthenogenesis of Cladocera, sex-ratio abnormalities among Copepods, and monogeny and intersexuality in Amphipods. Temperature appeared to play a role for sex realization in *Daphnia magna* with low temperatures favoring the appearance of arrhphonic females and high temperatures the appearance of males. In the preferential elimination of sex chromosomes during meiosis in the Cyclops viridis temperature was also significant. Monogeny and intersexuality existing in some populations of *Orchestia gammarella* depended on temperature during the breeding of females and their broods. Broods with female excess and intersex males are obtained at 17 C while normal broods or with excess of males are obtained at 22 C. (Chilton-ORNL)  
W76-12719

EARLY SURVIVAL AND RECRUITMENT OF SMALLMOUTH BASS IN NORTHERN MICHIGAN,  
Institute for Fisheries Research, Ann Arbor, Mich.  
M. D. Clady.  
Journal of Wildlife Management, Vol. 39, No. 1, 1975, p 194-200, 1 fig, 5 tab, 10 ref.

Descriptors: \*Ecology, \*Environmental effects, \*Bass, \*Mortality, Growth stages, Temperature, Fish, Age, \*Michigan, Water pollution effects.

Survival for six life history stages from egg to fall fingerling were estimated for the 1967, 1968, and 1969 cohorts of smallmouth bass. Percentages of egg potentials deposited on nests ranged from 15 to 34%. Survival between egg deposition and post-larval stage ranged from 26-33%. Strength of year class was significantly correlated with summer temperatures when cohorts were measured later in life but not when year classes were measured at the end of the first year. This might suggest that weather is important in determining survival subsequent to September of the first growing season. (Chilton-ORNL)  
W76-12720

MORTALITY OF THE EARLY DEVELOPMENTAL STAGES OF THE ROACH- RUTILUS RUTILUS (LINNAEUS, 1758),  
Karlova Universita, Prague (Czechoslovakia). Dept. of Systematic Zoology.  
K. Cerny.  
Vestnik Ceskoslovenske Spolecnosti Zoologicke, Vol. 39, No. 2, 1975, p 81-93, 2 fig, 2 tab, 39 ref.

Descriptors: \*Ecology, \*Environmental effects, Fish, \*Mortality, Larvae, Water temperature, Water pollution effects.  
Identifiers: \*Roach larvae.

Data showed that mortality of roach larvae was closely associated with temperature, lowest mortality occurring at the highest temperature. An average temperature of 8.9 degrees C was unsuitable for development. At this temperature, the larvae had difficulties in filling the swim bladder, locomotion was slowed and ability to catch food was impaired. In starved larvae, the decline of larvae was faster at higher temperatures. A sudden

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### Group 5C—Effects Of Pollution

increase in mortality was observed during the first days following the final resorption of the yolk sac. It was concluded that increased mortality of fishes during the early developmental stages is the result of complicated interactions of a number of external ecological and internal factors and that it is impossible to infer which of these factors is the decisive one. (Chilton-ORNL)  
W76-12721

**SOME EFFECTS OF TEMPERATURE, CHLORINE AND COPPER ON THE SURVIVAL AND GROWTH OF THE COON STRIPE SHRIMP, PANDALUS DANAE**, Battelle Pacific Northwest Labs., Richland, Wash. Ecosystems Dept., and Battelle Pacific Northwest Labs., Richland, Wash. Marine Research Lab. C. I. Gibson, T. O. Thatcher, and C. W. Apts. Report BNWL-SA-5344, 24 p, 3 tab, 2 fig, 12 ref.

Descriptors: \*Environmental effects, \*Mortality, \*Growth rates, \*Shrimp, \*Water temperature, \*Copper, \*Chlorine, Thermal pollution, Water pollution effects, \*Bioassay.  
Identifiers: Critical Thermal Maximum.

From bioassays and growth rate experiments it was concluded that coon stripe shrimp are more resistant to chlorine when acclimated and exposed at 8-10 C than when acclimated at 8 C and exposed at 15-20 C or when acclimated and exposed at 15 C. The Critical Thermal Maximum increased with an increase in size and rate at which temperature was elevated. The optimal growing temperature for shrimp for periods up to one month was 16 C. Copper concentrations of 0.041 mg/l retarded the growth at 16 C over a one month period. Chlorine concentration of 0.18 mg/l was lethal at 16 C and reduced growth at 0.08 mg/l over a one month period. (Chilton-ORNL)  
W76-12722

**SIMULATION EXPERIMENTS ON THE MIGRATION OF GAMMARUS ZADDACHI AND GAMMARUS CHEVREUXI**, Amsterdam Univ. (Netherlands). Inst. of Taxonomic Zoology. H. B. Girisch, and H. G. Dennert. Bijdragen tot de Dierkunde, Vol 45, No 1, 1975, p 20-38, 29 fig, 4 tab, 19 ref.

Descriptors: \*Environmental effects, Migration, Aquatic animals, Diurnal, Temperature, Salinity, Tides, Currents(Water), Laboratory tests, \*Fish migration.  
Identifiers: \*Gammarus zaddachi, \*Gammarus chevreuxi.

A current chamber in which a tidal cycle could be simulated was used in the investigations of migratory activity of two species of Gammarus. The number of animals actively swimming against the current and the number drifting with the current was observed to be about equal. Migratory activity was influenced by population density and food supply as well as a diurnal periodicity. A combination of decreased current velocity followed by slow current in the opposite direction, with increased salinity and temperature caused a significant increase in activity of both species. An increase in one of these factors produced increased migratory activity to a lesser extent. No significant differences in migratory activities were seen between juveniles and adults. (Chilton-ORNL)  
W76-12724

**SPAWNING LITTORINA LITTOREA (L.) (GASTROPODA: PROSOBRANCHIATA)**, University Coll. of North Wales, Menai Bridge. Marine Science Labs. J. Grahame. Journal of Experimental Marine Biology and Ecology, Vol. 18, 1975, p 185-196, 6 fig, 2 tab, 15 ref.

Descriptors: \*Biology, \*Biorhythms, \*Spawning, \*Gastropods, \*Snail, Tides, Tidal effects.

Snails were collected from about mean tidal level and transferred to the laboratory for observation. Data showed good evidence for seasonality of breeding in the snails studied as well as diurnal and longer time scale fluctuations in spawn output. There was no evidence of any immediate effects by temperature fluctuations of 2-3C nor was there any evidence that transfer to the laboratory entrained a spawning rhythm. There were strong indications of a lunar/tidal rhythm in spawning. (Chilton-ORNL)  
W76-12725

**GROWTH AND MORTALITY OF TWO GROUPS OF OYSTERS, (CRASSOSTREA VIRGINICA GMELIN), MAINTAINED IN COOLING WATER AT AN ESTUARINE ELECTRIC POWER GENERATING STATION**, Moody Coll. of Marine Sciences and Maritime Research, Galveston, Tex. Dept. of Marine Sciences. G. H. Gilmore, S. M. Ray, and D. V. Aldrich. Report TAMU-SG-75-207, January 1975, 67 p, 9 tab, 16 fig, 38 ref. NASA 04-3-158-18.

Descriptors: \*Environmental effects, \*Thermal pollution, \*Oysters, \*Growth rates, \*Mortality, Ponds, Discharge(Water), Intakes, Powerplants, Cooling water, Water pollution effects.

Growth and mortality of oysters which were infected with Labyrinthomyxa marina was measured in samples collected from ponds receiving a continuous flow of heated water from an electric power plant, from the power plant intake canal, and from the power plant discharge canal. Pond oysters grew better and had less mortality than intake canal oysters regardless of infection. Highest infection occurred at the head of the discharge canal during warm seasons. Oysters held in the ponds grew as well or better than oysters from a natural reef. Evidence of oyster reproduction was also noted in the ponds. Oysters placed in the discharge canal during warm weather died within six weeks. (Chilton-ORNL)  
W76-12726

**EFFECT OF TEMPERATURE ON TOLERANCE TO DISSOLVED GAS SUPERSATURATION OF BLACK BULLHEAD, ICTALURUS MELAS**, Battelle-Northwest, Richland, Wash. D. H. Fickeisen, J. C. Montgomery, and R. W. Hanf, Jr. Report BNWL-SA-5175, CONF-741033-1 from a workshop on Gas Bubble Disease held in Richland, Washington, October 8, 1974, 10 p, 5 fig, 3 ref. AT(45-1)-1830.

Descriptors: \*Environmental effects, \*Gases, \*Temperature, \*Bullheads, Bioassays, \*Supersaturation, Resistance, Water pollution effects, Thermal pollution.  
Identifiers: Acclimation temperature, \*Gas bubble disease.

A progress report on continuing work is presented. Fish were acclimated to test temperature (8, 12, 16, and 20 degrees C) prior to exposure to supersaturation. The data were subjected to probit analysis and mean 96-hour TL50 values were 126.7% of equilibrium saturation at 8 degrees C, 125.1% at 12 C, 123.8% at 16C, and 124.4% at 20 C, indicating a slightly elevated tolerance at the lowest test temperature. It was concluded that the effect of temperature within the range tested had little effect on tolerance of black bullhead acclimated to the test temperature. It was suggested that the combined effects of thermal shock and supersaturation might produce a different effect. (Chilton-ORNL)  
W76-12727

**REPRODUCTION AND RECRUITMENT OF THE BRACKISH WATER CLAM RANGIA CUNEATA IN THE JAMES RIVER, VIRGINIA**, Nuclear Regulatory Commission, Washington, D.C. Div. of Technical Review. T. D. Cain. Fishery Bulletin, Vol. 73, No. 2, 1975, p 412-430, 17 fig, 2 tab, 34 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Salinity, Reproduction, Spawning, Gonads, \*Clams, Estuaries, Brackish water, \*Virginia.  
Identifiers: Gametogenesis, \*Rangia cuneata, \*James River estuary(Va).

The major objectives were to study the gametogenic cycle of Rangia from histological sections, to determine differences in gametogenesis or spawning of clams over the species range in the James River estuary, to investigate the influence of temperature and salinity on initiation of gametogenesis and spawning, to corroborate gametogenic findings by collecting newly set clams, and to determine the duration of the larval period and differences in set abundance in the estuary. Correlation of environmental data to gonadal conditions suggested that temperature and salinity are both important factors with salinity being more important in spawning while temperature appeared to be the more important stimulus in initiating gametogenesis in the spring and summer. (Chilton-ORNL)  
W76-12728

**EXPERIMENTS AND OBSERVATIONS ON THE FEEDING BEHAVIOR OF THE FRESHWATER LEECH ERPOBDELLA OCTOCULATA (L.) (HIRUDINEA: ERPOBDELLIDAE)**, State Univ. of New York Agricultural and Technical Coll. at Morrisville. K. L. Greene. Archives of Hydrobiology, Vol. 74, No. 1, 1974, p 87-99, 1 fig, 3 tab, 10 ref.

Descriptors: \*Environmental effects, \*Feeding rates, Behavior, Aquatic life, Temperature, Light, Bottom sediments.  
Identifiers: \*Leeches(Feeding behavior).

Investigations were made under laboratory conditions. Leeches were observed to find food by random probing of the environment. Leeches consumed one or two chironomid larvae (the preferred prey) in each 24 hour period and generally rested after the second capture. Various substrate conditions appeared to have less effect as leeches grew larger. Although leeches fed at temperatures as low as 2 degrees C, feeding activity reached 60-70% and remained relatively constant between 7-12 degrees C. No endogenous rhythm could be found but it was observed that feeding activity was greater at very low light intensities. (Chilton-ORNL)  
W76-12729

**THERMAL EFFECTS ON THE ACCUMULATION OF ARSENIC IN GREEN SUNFISH, LEPOMIS CYANELLUS**, Texas Univ. at Austin. Dept. of Zoology. E. M. B. Sorensen. Archives of Environmental Contamination and Toxicology, Vol. 4, 1976, p 8-17, 5 fig, 20 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Arsenic, \*Sunfishes, Mortality, Thermal stress, \*Thermal pollution, \*Neutron activation analysis, \*Pollutant identification.

Neutron activation analysis was used to measure the pattern of arsenic concentration in tissues of Lepomis cyanellus as a function of exposure time at 10, 20, and 30 degrees C and with arsenic concentrations of 0, 30, and 60 ppm of sodium arsenate. The general trends of increasing arsenic uptake (in liver, gut and muscle) with increasing



temperature, arsenic concentration and time of exposure were apparent despite variability between individual fish. Temperature quotient values for arsenic uptake in liver tissue had a mean of 4.5. These elevated values suggested that elevated heat and high metal concentrations act synergistically in heavy metal uptake. As temperature increased from 10 to 20 to 30 C at 60 ppm of arsenic, percent survival was reduced so that 50% mortality values decreased from 678 to 210 to 124 hr. respectively. At arsenic concentrations of 30 ppm and temperatures of 20 and 30 C, 50% mortality values were 527 and 209 hr., respectively. (Chilton-ORNL) W76-12731

#### THE RESPONSE OF LARVAL FISH, *LEIOSTOMUS XANTHURUS*, TO ENVIRONMENTAL STRESS FOLLOWING SUBLETHAL CADMIUM EXPOSURE.

National Marine Water Quality Lab., Johns Island, S.C.  
D. P. Middaugh, W. R. Davis, and R. L. Yoakum.  
Contributions in Marine Science, Vol. 19, 1975, p 13-19, 2 fig, 3 tab, 16 ref.

Descriptors: \*Environmental effects, \*Cadmium, Larvae, Fish, Thermal stress, Dissolved oxygen, \*Mortality, \*Lethal limit, \*Toxicity, Water pollution effects.  
Identifiers: Critical thermal maximum, \**Leiostomus xanthurus*.

An incipient LC50 of 0.2-0.3 mg cadmium per liter was estimated from previous data. In subsequent short-term sublethal exposures, concentrations of cadmium measured in respective treatment aquaria were 0.09, 0.5, and 0.8 mg/l. At the 0.8 mg/l concentration 20% of the larvae died by the end of the 96 hour exposure interval. No deaths occurred at exposure concentrations of 0.09 and 0.5 mg/l cadmium. Exposure of larval spot to elevated temperature regimes or suppressed dissolved oxygen levels showed significant decreases in these two factors at cadmium concentrations of 0.5 and 0.8 mg/l. Significant reduction in the capability of larvae to survive thermal stress or low dissolved oxygen after exposure to sublethal concentration of cadmium demonstrates the potential detrimental effect of this metal in the marine environment. (Chilton-ORNL) W76-12732

**OSMOREGULATION IN *TRICHOCCORIXA VERTICALIS INTERIORES* SAILER (HEMIPTERA, CORIXIDAE) - AN INHABITANT OF SASKATCHEWAN SALINE LAKES, CANADA.**  
Saskatchewan Univ., Saskatoon. Dept. of Biology.  
P. I. Tones, and U. T. Hammer.  
Canadian Journal of Zoology, Vol. 53, No. 9, 1975, p1207-1212, 3 fig, 1 tab, 15 ref.

Descriptors: \*Laboratory tests, Biology, Osmosis, Insects, Temperature, \*Salinity, Environmental effects, \*Canada, Saline lakes, Water pollution effects.  
Identifiers: \*Osmoregulation, \*Hemipterans, \**Trichocorixa verticalis interiores*.

*T. verticalis interiores* were collected from six athalassic saline lakes which represented a wide range of salinities. The six lakes are all sulfate lakes in which sodium and magnesium are the major cations. The maximum density of adults per square meter in the six lakes ranged from 2 to 1978. Data from freezing point depression determinations of haemolymph showed that first instars, third instars and adults of the species have well-developed osmoregulation and can hyporegulate in saline water. Although the species can osmoregulate equally well at 13, 20, and 25 degrees C, the mean tolerance limit decreases as the temperature increases. (Chilton-ORNL) W76-12733

**DIATOM COMMUNITIES FROM A DELAWARE SALT MARSH.**  
Delaware Univ., Newark. Dept. of Biological Sciences.  
M. J. Sullivan.  
Journal of Phycology, Vol. 11, No. 4, 1975, p 384-390, 5 tab, 13 ref.

Descriptors: \*Ecology, Water pollution effects, \*Delaware, \*Salt marshes, \*Diatoms, On-site investigations, \*Algae, Grasses, \*Habitats, Temperature, Salinity, Distribution.

Edaphic diatoms were collected from 5 habitats of a salt marsh. Three of the habitats supported stands of grass while the other 2 were a bare bank and a panne. The habitats supporting grasses yielded the highest species diversity and the greatest number of diatoms. The bank and the panne were exposed to hypersaline conditions during warmer periods and this was considered a contributing factor to lower values for those habitats. The panne had the highest average temperature of the five habitats and the tall grass habitat had a surface temperature almost identical to the standing water temperature throughout the year. Each habitat supported its own unique and easily recognizable edaphic diatom community. Differences between the habitats were closely related to differences in temperature and elevation and to interactions between diatoms and filamentous algae. (Chilton-ORNL) W76-12734

#### EFFECTS OF POLLUTION ON FRESHWATER FISH, (LITERATURE REVIEW).

National Water Quality Lab., Duluth, Minn.  
J. M. McKim, D. A. Benoit, K. E. Biesinger, and W. A. Brungs.  
Journal Water Pollution Control Federation, Vol. 47, No. 6, June 1975, p 1711-1768, 1 tab, 409 ref.

Descriptors: \*Reviews, \*Environmental effects, \*Water pollution, Freshwater fish, Pollutants, Toxicity, Temperature, Water quality, \*Bibliographies.

The effects of water pollution on freshwater is reviewed. Included in the review is information on methodology, water quality, pesticides, industrial pollutants, domestic and chlorinated pollutants and radioactive pollutants. A summary of the acute and chronic toxicity of inorganic and organic pollutants to freshwater fish, which provides information on species, exposure time, exposure type, temperature, effect endpoint, and concentration is provided. (Chilton-ORNL) W76-12735

#### THERMAL EFFECTS, (LITERATURE REVIEW).

Oak Ridge National Lab., Tenn.  
C. C. Coutant, and H. A. Pfuderer.  
Journal Water Pollution Control Federation, Vol. 46, No. 6, June 1974, p 1477-1516, 8 tab, 23 ref.

Descriptors: \*Reviews, \*Thermal water, Thermal stress, \*Thermal pollution, Aquatic life, Environmental effects, \*Bibliographies, Water pollution effects.

The 1973 literature pertaining to thermal effects on aquatic organisms is reviewed. Categories to which particular attention is given include power plant studies, producers, reproduction, development, morphology, distribution, thermal tolerance, tissue and organ responses, oxygen metabolism, growth, feeding, predator-prey relations, diseases, beneficial uses, and other effects of thermal stress. (Chilton-ORNL) W76-12736

**CESIUM 137 ACTIVITIES IN FISH RESIDING IN THERMAL DISCHARGES TO LAKE MICHIGAN.**  
Argonne National Lab., Ill. Radiological and Environmental Research Div.  
S. A. Spigarelli.  
Health Physics, Vol. 30, May 1976, p 411-413, 1 fig, 1 tab, 12 ref.

Descriptors: \*Environmental effects, \*Water pollution effects, \*Radioactivity effects, Radioecology, \*Thermal water, Fish, Cesium, Salmonids, Chinook salmon, Rainbow trout, Brown trout, \*Thermal pollution.

The goals of the study were to compare Cs 137 activities in plume resident fish with fish from unheated areas, to compare the residence effect on three important sport fish (brown trout, Rainbow trout, and Chinook salmon), and to evaluate the radioecological significance of thermal discharge residence on temporal trends in Cs 137 accumulation by salmonid fish in Lake Michigan. In 1973, the mean Cs 137 activities in plume fish were higher than those of reference fish for each species. However, covariance analysis showed no statistical difference between plume and reference samples of rainbow trout or chinook salmon; the mean Cs 137 activity of plume brown trout was significantly higher than the mean activity of reference brown trout. It is concluded that differences in Cs 137 activities between species may be the result of differential feeding habits or metabolic requirements. (Chilton-ORNL) W76-12738

**WARM WATER EFFLUENTS AND PLANKTON, (IN JAPANESE).**  
Seikai Regional Fisheries Research Lab., Nagasaki (Japan).  
M. Anraku.  
Bull. Plankton Soc. Jpn. 21(1), p 1-31, 1974.

Descriptors: Cyanophyta, Algae, Diatoms, Effluents, Microorganisms, \*Diatoms, Primary productivity, \*Phytoplankton, \*Dinoflagellates, Fish, \*Zooplankton, \*Thermal pollution, \*Succession, Chlorophyta.

The influence of warm water effluents on the ecology and physiology of phyto- and zooplankton in inshore water is reviewed. A change of species composition of phytoplankton was observed in the field and in experimental pools following the addition of warm water effluents. The diatom population may be replaced by green algae with gradual increase of temperature and succeeded by a population of blue-green algae. On certain occasions, diatoms give way to dinoflagellates with increasing temperature. Species diversity is heightened with temperature rise, and the biomass of a single cell also increases. Since diatoms are more important as foods of microorganisms than are other algae, the succession from diatoms to other algal populations may change pathways of energy flow in a stable food chain system and thus influence the ecosystem. Primary productivity is variable in thermal effluents. Increased water temperature has either an inhibitive or a stimulative effect on the productivity depending on the temperature of the intake water. The study of the influence of warm water effluents on the production of zooplankton should be continued after the installation of a power plant. The increase of warm water species may induce a decrease of cold water zooplankton. The change of species composition may affect the feeding of their predators, especially in the early developmental stages of fish. In general, rates of metabolism and activity of zooplankton increase with increasing temperature over most of the species-specific temperature tolerance range and decrease suddenly near the upper limit. The rates of increase are usually different for different species, and frequently for different biological processes. The temperature rise with heated effluents accelerates the metabolic rates within the range of tolerance. Patterns of

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

energy flow might also be altered by changes in body size of individual species caused by temperature changes.—Copyright 1975, Biological Abstracts, Inc.  
W76-12740

**EFFECTS OF ACCLIMATIZATION AND PHYSIOLOGICAL STATE ON THE TOLERANCE TO HIGH TEMPERATURES AND REACTIONS TO DESICCATION OF THEODOXUS FLUVIATILIS AND LYMNEA PEREGRINA.**  
Stockholm Univ. (Sweden). Dept. of Zoology; and Stockholm Univ. (Sweden). Asko Lab.  
G. Skoog.  
Oikos, Vol. 27, 1976, p 50-56, 6 fig, 2 tab, 18 ref.

Descriptors: \*Laboratory tests, Environmental effects, \*Temperature, \*Snails, Drying, Seasonal, Physiology, Resistance, \*Thermal pollution.  
Identifiers: \*Lymnea peregrina, \*Theodoxus fluviatilis.

Laboratory experiments showed that both adult and juvenile *Lymnea peregrina* were more tolerant to high temperatures than *Theodoxus fluviatilis*. Field distributions corroborate the laboratory data. *L. peregrina* exhibited a drastic drop in heat tolerance during the egg laying phase. Desiccating conditions seem to be more hazardous to *L. peregrina* as it is physiologically less tolerant to the effects of drying and dies sooner than *T. fluviatilis*. However, the behavioural response to desiccation including rapid movements offers a chance of reaching water which is not open to *T. fluviatilis*. (Chilton-ORNL)  
W76-12741

**TOXICITY OF NATURAL PYRETHRINS AND FIVE PYRETHROIDS TO FISH.**  
Fish and Wildlife Service, La Crosse, Wis. Fish Pesticide Research Unit.  
W. L. Mauck, L. E. Olson, and L. L. Marking.  
Archives of Environmental Contamination and Toxicology, Vol. 4, 1976, p 18-29, 5 tab, 23 ref.

Descriptors: \*Laboratory tests, \*Toxicity, \*Pesticides, Environmental effects, Fish, Temperature, Hydrogen ion concentration, Salmonids, Channel catfish, Yellow perch, Minnows, Trout, Water pollution effects.  
Identifiers: \*Pyrethrins, \*Pyrethroids.

The toxicity of natural pyrethrins and five pyrethroids was determined with coho salmon, steelhead trout, fathead minnow, channel catfish, bluegill, and yellow perch. The order of toxicity of pyrethrum extract and pyrethroids from most toxic to least toxic based on active ingredient was found to be RU-11679, SBP-1382, pyrethrum extract, S-bioallethrin, dimethrin, and d-trans allethrin. All the compounds were more toxic to cold water species. Pyrethrum extract and four of the pyrethroids were more toxic in cold water with d-trans allethrin being more toxic in warm water. Pyrethrum extract was more toxic in pH 6.5 than in high pH water. Pyrethroids were not influenced by pH in the range of 6.5 - 9.5. RU-11679 and SBP-1382 were most rapidly deactivated. Toxicity of dimethrin and d-trans allethrin was least influenced by temperature, water hardness and pH. (Chilton-ORNL)  
W76-12742

**FISH INVESTIGATIONS IN LONG ISLAND SOUND AT A NUCLEAR POWER STATION SITE AT SHOREHAM, NEW YORK.**  
New York State Dept. of Environmental Conservation, Albany.  
For primary bibliographic entry see Field 2L.  
W76-12743

**CHARACTERIZATION OF THE FACTORS RESPONSIBLE FOR DEATH OF FISH INFECTED WITH VIBRIO ANGUILLARUM.**  
Delaware Univ., Newark. Dept. of Biological Sciences.

T. H. Umbreit, and M. R. Tripp.  
Canadian Journal of Microbiology, Vol. 21, No. 8, 1975, p 1272-1274, 3 tab, 11 ref.

Descriptors: \*Bacteriology, \*Biochemistry, Toxins, Fish, Bacteria, \*Heat, Mortality, Cultures, Toxicity, Water pollution effects.  
Identifiers: \*Vibrio anguillarum.

Experimental goldfish were injected intraperitoneally with live bacteria (*Vibrio anguillarum*) in culture medium; heat killed bacteria; supernatant fluid; and heated supernatant fluid. Fish injected with 10 to the 9th power live bacteria died within 6 days. Vibrios were most abundant in gills, liver, intestinal tract, and coelomic fluid. Fish injected with dead bacteria showed almost identical mortality rates as did those fish injected with the cell free supernatant. It was concluded that *Vibrio anguillarum* produces substances toxic to goldfish that are released from live bacteria and associated with heat-killed bacteria. Heating (100 C) enhances the potency of the extracellular toxin. (Chilton-ORNL)  
W76-12745

**MECHANISM OF DEATH AT HIGH TEMPERATURES IN HELIX AND PATELLA.**  
Trinity Coll., Dublin (Ireland). Dept. of Zoology.  
J. N. R. Grainger.  
Journal of Thermal Biology, Vol. 1, 1975, p 11-13, 2 tab, 15 ref.

Descriptors: Physiology, \*Mortality, \*Mollusks, Temperature, \*Thermal stress, Sodium, Potassium, Thermal pollution, Water pollution effects, \*Respiration.  
Identifiers: Tissue respiration, \*Helix, \*Patella, \*Na/K ratio.

Results of respiration measurements on tissues from normal and heat dead animals showed the oxygen consumption to be steady with no decline after 40 min. A significant fall in blood Na and a significant rise in blood K was observed in heat dead *Helix* demonstrating a major disturbance in the Na/K ratio. A significant disturbance in the Na/K ratio was also seen in *Patella* but this was entirely due to a rise in blood Na. These disturbances are thought to be a prime cause of heat death. (Chilton-ORNL)  
W76-12746

**RECENT CYCLIC CHANGES IN CLIMATE AND IN ABUNDANCE OF MARINE LIFE.**  
Marine Biological Association of the United Kingdom, Plymouth (England).  
A. J. Southward, E. I. Butler, and L. Pennycuik.  
Nature, Vol. 253, February 1975, p 714-717, 2 fig, 1 tab, 33 ref.

Descriptors: \*Environmental effects, Meteorology, \*Climatology, Marine fisheries, Oceans, Temperature, Fish populations, \*Thermal pollution, Water pollution effects.

A review is presented of interactions between the sea, sea currents and the atmosphere which have important meteorological consequences and may also have direct or indirect effects on fisheries. Emphasis is placed on the effects of temperature on fisheries production. (Chilton-ORNL)  
W76-12747

**PHYTOPLANKTON GENERIC DIVERSITY AND BIOMASS ESTIMATES OF A MONOGAHELA RIVER ACID CONFLUENCE.**  
West Virginia Univ., Morgantown. Dept. of Biology.  
D. Rankin, and E. C. Keller, Jr.

Proceedings of the West Virginia Academy of Science, Vol. 45, No. 2, p 169-177, 3 tab, 1 append, 16 ref.

Descriptors: \*Environmental effects, \*Water pollution effects, Acidic water, \*Acid streams, Plankton, \*Phytoplankton, Water quality, \*Euglena, \*Biomass.  
Identifiers: Monogahela River(WV).

The effects of acid drainage on water quality were a decrease in pH, a decrease in dissolved oxygen and percent saturation, and an increase in hot and cold acidity levels. Aquatic organisms were found to be reduced in diversity and density with *Euglena* being the only genus found. Recovery was evidenced by an increase in generic diversity and density and generally better water quality downstream from the confluence. (Chilton-ORNL)  
W76-12748

**FACTORS CONTROLLING RATES OF METHANE OXIDATION AND THE DISTRIBUTION OF THE METHANE OXIDIZERS IN A SMALL STRATIFIED LAKE.**  
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.  
For primary bibliographic entry see Field 5B.  
W76-12750

**LATITUDINAL VARIATION IN THE LIFE HISTORY FEATURES OF THE BLACK TURBAN SNAIL (TEGULA FUNEBRALIS) (PROSOBRANCHIA: TROCHIDAE).**  
Oregon Univ., Eugene. Dept. of Biology.  
P. W. Frank.  
Marine Biology, Vol. 31, 1975, p 181-192, 1 fig, 4 tab, 32 ref.

Descriptors: \*Ecology, \*Environmental effects, \*Snails, \*Latitudinal studies, Temperature, Predation, Aquatic populations, Density, Food abundance.

Identifiable factors that affect the life history attributes of *Tegula funebris* include latitude, population density as related to food supply settlement and recruitment rate of young, and predation. This study was concerned with latitude and to an extent density. At higher latitude the species was found to live longer, grow more slowly, and attain a larger size than further south. Age distribution was less predictable at higher latitudes. These differences are explained by either a temperature effect together with increased hazards to planktonic larvae in the north or a combination of interactions between intensity of predation, population density and food supply. Growth rates of transplanted individuals suggested a genetic basis for the latitudinal differences. (Chilton-ORNL)  
W76-12751

**FEEDING CHARACTERISTICS AND PREDATION IMPACT OF CHAOBORUS (DIPTERA, CHAOBORIDAE) LARVAE IN A SMALL LAKE.**  
Toronto Univ. (Ontario). Inst. for Environmental Studies and Engineering.  
For primary bibliographic entry see Field 2H.  
W76-12752

**SPAWNING OF LAKE WHITEFISH, COREGONUS CLUPEIFORMIS, AND ROUND WHITEFISH, PROSOPOM CYLINDRACEUM, IN AISHIHIK LAKE AND EAST AISHIHIK RIVER, YUKON TERRITORY.**  
Fisheries and Marine Service, Vancouver (British Columbia). Vancouver Lab.  
For primary bibliographic entry see Field 2H.  
W76-12754

**BEHAVIORAL THERMOREGULATION IN HYPHOPHYSECTOMIZED AND SHAM-**

**OPERATED RAINBOW TROUT, SALMO GARDNERI**

Western Washington State Coll., Bellingham.  
L. H. Frank, and M. E. Meyer.  
Behavioral Biology, Vol. 11, 1974, p 101-108, 3 fig, 14 ref.

Descriptors: \*Environmental effects, Behavior, \*Fish behavior, Temperature, Trout, Salmonids, Laboratory tests, \*Rainbow trout, Water temperature, Thermal stress.  
Identifiers: \*Thermoregulation.

Experimental data indicated that both sham-operated and hypophysectomized rainbow trout were able to reduce their mean water temperature over days through an increase in response rate and number of reinforcements. No significant difference exists in the ability of the two to behaviorally regulate the ambient temperature. The results demonstrate that temperature variability increased over days in hypophysectomized and sham-operated trout as compared to the narrowing of variability over sessions previously observed in normal and hypophysectomized rats. The findings suggest a lack of hypophyseal involvement in behavioral temperature regulation in the trout. (Chilton-ORNL)  
W76-12755

**MOVEMENTS AND GROWTH OF ARCTIC GRAYLING (THYMALLUS ARCTICUS) AND JUVENILE ARCTIC CHAR (SALVELINUS ALPINUS) IN A SMALL ARCTIC STREAM, ALASKA.**  
Aquatic Environments Ltd., Crossfield (Alberta).  
P. C. Craig, and V. A. Poulin.

Journal of the Fisheries Research Board of Canada, Vol. 32, No. 5, 1975, p 689-697, 4 fig, 1 tab, 24 ref.

Descriptors: \*Fish behavior, \*Ecology, Spawning, Juvenile fish, Fry, Streams, \*Alaska, Growth rates, Water pollution effects.

The study of fish utilization of a small stream was investigated because of the likelihood that similar streams in the north may be affected by roadways, pipelines, and increased human activity. The stream served as a spawning and nursery area for Arctic grayling with adults entering the stream soon after breakup and leaving after spawning. Juvenile grayling and char entered the stream to feed. Grayling fry emerged from the gravel in late June to early July and remained until freeze-up. The growth rate for grayling in the stream was found to be faster than normal. (Chilton-ORNL)  
W76-12756

**THE ABILITY OF THE CICHLID FISHES TILAPIA RENDALLE BOULENGER, TILAPIA SPARRMANII A. SMITH AND HEMIAPHLOCHROMIS (PSEUDOCRENILABRUS) PHILANDER (M. WEBER) TO ENTER DEEP WATER.**  
Rhodes Univ., Grahamstown (South Africa) Inst. of Freshwater Studies; and Rhodes Univ., Grahamstown (South Africa). Dept. of Zoology and Entomology.  
M. S. Caulton.

Journal of Fish Biology, 1975, Vol. 7, p 513-517, 2 fig, 1 tab, 5 ref.

Descriptors: \*Environmental effects, \*Freshwater fish, \*Cichlids, \*Tilapia, Pressure, Temperature, Juvenile fish, Fry, Fish.

Data showed that adult T. rendalli compensated for pressure to a depth of 8.5 m and T. sparrmanii to a depth of 15 m at 22 degrees C. The latter species required a period of 8 days to descend to 15 m and return to the surface if complete equilibration were maintained. Adult H. philander males compensated to a maximum depth of 16 m at 22 C and 20 m at 30 C, whereas the females descended to a depth of 26 m at 22 C and 27 m at 30 C. Fry and ju-

veniles were capable of descending to greater depths and were capable of more rapid depth compensation than were adults. (Chilton-ORNL)  
W76-12759

**THERMAL TRANSITIONS OF COLLAGEN FROM FISH RECOVERED FROM DIFFERENT DEPTHS.**

Commonwealth Scientific and Industrial Research Organization, Sydney (Australia).  
B. J. Rigby, and C. L. Prosser.  
Comparative Biochemistry and Physiology, Vol. 52B, 1975, p 89-90, 2 tab, 7 ref.

Descriptors: Environmental effects, \*Thermal stress, \*Fish, Depth, Deep water, Shallow water, Temperature, Thermal pollution.  
Identifiers: \*Collagen.

Connective tissues which contain collagen as their main fibrous protein are known to exhibit thermal transition (due predominantly to the melting of molecular collagen) when heated. In dilute solution the collagen molecule undergoes a melting transition at a temperature which is characteristic of the species from which the collagen has been obtained. Melting temperature in acid of collagen from the skin of fish taken at 2000m depth with a habitat temperature of 2-4 C were 14 C; from flatfish taken at depths of 200m with a habitat temperature of 16-18 C were 25 C; and from reef fish with a habitat temperature of 24 C were 27 C. It was concluded that transition temperatures may correspond to lower and upper temperatures of the thermal preferendum. (Chilton-ORNL)  
W76-12760

**BEHAVIOR OF LOBSTERS (HOMARUS AMERICANUS) IN A SEMI-NATURAL ENVIRONMENT AT AMBIENT TEMPERATURES AND UNDER THERMAL STRESS.**

Woods Hole Oceanographic Institution, Mass.  
L. Stein, S. Jacobson, and J. Atema.  
Report WHOI-75-48, October 1975, 49 p, 9 tab, 12 fig, 13 ref. AT(11-1) 3567 & E(11-1) 2546.

Descriptors: \*Environmental effects, \*Thermal stress, Laboratory tests, Behavior, \*Lobsters, Temperature, Thermal pollution, Water pollution effects.

Identical semi-natural habitats in two 10 foot diameter, octagonal aquaria were established, each containing five lobsters. Behavioral observations were made during the day, following feeding, and just after sunset (when lobsters are active under natural conditions) from February to August of 1974. Behavior patterns observed included shelter occupation, feeding, activity, and social behavior as exhibited by dominance, territoriality, mating, and aggression. Temperatures in the investigation ranged from 5 to 28 C. Patterns of residence and dominance in the lobsters changed seasonally. The direction of change was different in each tank and did not seem to be correlated with temperature. (Chilton-ORNL)  
W76-12761

**PERIPHYTON CROPS AND PRODUCTIVITY IN A REACTOR THERMAL EFFLUENT.**

Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.  
L. J. Tilly.  
Report DP-MS-74-77, For presentation at the 38th Annual Meeting of the American Society of Limnology and Oceanography, held in Halifax, Nova Scotia, June 23-26, 1975. 21 p, 6 fig, 4 tab, 7 ref. CONF-750668-1. AT(07-2)-1.

Descriptors: \*Environmental effects, \*Thermal pollution, \*Periphyton, Biomass, \*Productivity, Standing crop, Temperature, Water quality, Photosynthesis, Ponds.

Periphyton samples on glass slides were placed at 7 locations in Par Pond (encompassing high-to-ambient temperatures and protected-to-open water conditions) for two weeks. The samples were examined for differences in species composition, diversity, standing crop, and C 14 uptake. For stations with average temperature differences of less than 5 C, weight specific productivity differed by a factor of 7. Periphyton biomass differed more than fivefold between stations 5.5 C apart. Weight specific productivity and accumulated crop correlated highly with average growing temperature, but slopes of regressions from consecutive periods often differed greatly while species composition and temperature regime changed only slightly. (Chilton-ORNL)  
W76-12762

**METABOLIC STUDIES ON THE AMPHIPOD ANISOGAMMARUS PUGETENSIS IN RELATION TO ITS TROPHIC POSITION IN THE FOOD WEB OF YOUNG SALMONIDS.**  
British Columbia Univ., Vancouver. Inst. of Oceanography.

B. D. Chang, and T. R. Parsons.  
Journal of the Fisheries Research Board of Canada, Vol. 32, No. 2, 1975, p 243-247, 2 fig, 2 tab, 16 ref.

Descriptors: Ecology, \*Food webs, \*Metabolism, \*Amphipoda, Temperature, Salinity, Growth rates, \*Life cycles, Habitats.  
Identifiers: \*Anisogammarus pugetensis.

The purpose was to study Anisogammarus pugetensis' life cycle, metabolism, and food requirements in relation to its habitat and to investigate its potential as an organism for food for young fish. It was concluded that the principal advantage to the mass cultivation of this organism as opposed to many pelagic species would be its ability to tolerate a wide range of temperatures and salinities and to survive upon different kinds of food. At a salinity of 28‰ and a temperature of 20 degrees C, it grew at a rate of 14% of body weight per day. Growth efficiency was between 19 and 34%. (Chilton-ORNL)  
W76-12763

**TEMPERATURE RESPONSES OF A COCCOLITHOPHORID, CRICOSPHAERA CARTERAE, MEASURED IN A SIMPLE AND INEXPENSIVE THERMAL-GRADIENT DEVICE.**  
Duke Univ., Beaufort, N.C. Marine Lab.  
For primary bibliographic entry see Field 5A.  
W76-12764

**COMBINED EFFECTS ON THE ENVIRONMENT OF RADIOACTIVE, CHEMICAL AND THERMAL RELEASES FROM THE NUCLEAR INDUSTRY, (REPORT ON THE INTERNATIONAL SYMPOSIUM HELD IN STOCKHOLM JUNE 2-5, 1975).**  
International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety and Environmental Protection.  
P. J. West.

Atomic Energy Review, Vol. 13, No. 3, p 629-634.

Descriptors: Reviews, \*Conferences, \*Environmental effects, \*Thermal pollution, Chemical wastes, \*Radioactive wastes, Nuclear energy, \*Radioactivity.  
Identifiers: Synergism.

Papers presented at the symposium are reviewed. The majority of the papers were concerned with aquatic ecosystems and included the effects of temperature on radionuclide uptake, synergism and combination effects in aquatic systems, effects of chemical releases on radionuclide uptake, synergism and combination effects from releases to the atmosphere, and other factors in assessment of synergistic and combination effects. (Chilton-ORNL)  
W76-12765



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

#### ANNULUS FORMATION AND GROWTH OF TIGERFISH, HYDROCYNUS VITTATUS, IN LAKE BANGWEULU, ZAMBIA.

Zambia Dept. of Fisheries, Samfya. Fishery Research Div.  
J. S. Griffith.

Transactions of the American Fisheries Society, Vol. 104, No. 3, 1975, p 499-505, 3 tab, 4 fig, 12 ref.

Descriptors: \*Environmental effects, \*Temperature, \*Aging(Biological), Fish, Growth rates, Growth stages, Lakes, Africa.  
Identifiers: \*Scale analysis, \*Lake Bangweulu(Zambia).

The validity of scale analysis for aging tigerfish was assessed by examining the timing and cause of check formation on scales. Circuli which appeared to be valid annuli formed discontinuities on all scales under conditions of water temperature rising rapidly after a drop to 18 degrees C. The study does not indicate any other factors that could stimulate the formation of scale checks at the time these appeared. The lake level was dropping but did not reach a minimum until two to three months later and there was no indication that food availability decreased at the time of the check. (Chilton-ORNL)  
W76-12767

#### THE EFFECTS OF POWER PLANT CONDENSER COOLING WATER ENTRAINMENT ON THE AMPHIPOD, GAMMARUS SP.,

New York Univ. Medical Center, N. Y. Lab. for Environmental Studies.  
T. C. Ginn, W. T. Waller, and G. J. Lauer.

Water Research, Vol. 8, 1974, 937-945, 6 fig, 4 tab, 14 ref.

Descriptors: \*Environmental effects, \*Thermal pollution, Mortality, \*Amphipoda, Entrainment, Cooling water, Powerplants, Temperature, Water pollution effects.  
Identifiers: \*Gammarus sp.

Mean per cent survival of Gammarus sp. sampled during temperature rises of 7.1-8.3C at ambient temperatures of 24.9-26.0C was 98.5 and 97.4% for two intake stations and 90.1 and 96.8 for the two discharge stations. Increased initial and latent mortalities were observed during periods of condenser chlorination. Mean intake abundances were about an order of magnitude higher at night than during the day. Thermal tolerance of Gammarus sp. appeared to be dependent on exposure time and ambient temperature. Temperatures causing a 50% mortality for 30 min. exposure times increased about 11C as ambient temperatures increased 2.5 to 25.8C. (Chilton-ORNL)  
W76-12768

#### THERMAL EFFECTS OF POWER PLANT ENTRAINMENT ON SURVIVAL OF FISH EGGS AND LARVAE: A LABORATORY ASSESSMENT,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.  
J. R. Schubel, T. S. Y. Koo, and C. F. Smith.  
Chesapeake Bay Institute, Special Report 52, Reference 76-4, PPRP-13, 38 p, May 1976, 9 tab, 2 fig, 34 ref, append.

Descriptors: \*Environmental effects, \*Thermal pollution, \*Fish eggs, Larvae, Temperature, \*Entrainment, Resistance, Mortality, Laboratory tests, Freshwater fish, Striped bass, Herrings, Shad.

Blueback herring, American shad, and striped bass eggs and larvae were subjected to time-excess temperature histories typical of those experienced by organisms entrained by power plants with a variety of design and operating criteria. Excess temperatures ranged from 7-20C above base temperature, exposure time from 4-60 minutes, and cooling time from 60-300 minutes. Excess tem-

peratures of 20C resulted in almost 100% mortality to eggs of all three species. Analyses of variance indicated that excess temperature exposures of 15C significantly reduced the hatching success of blueback herring and American shad eggs but not of striped bass eggs. Excess temperatures of 20C also caused almost 100% mortality of larvae in all three species. Striped bass larvae could withstand excess temperatures of up to 10C with no significant increase in mortality. (Chilton-ORNL)  
W76-12769

#### SITE AND DESIGN TEMPERATURE RELATED ECONOMICS OF NUCLEAR POWER PLANTS WITH EVAPORATIVE AND NON-EVAPORATIVE COOLING TOWER SYSTEMS,

Gilbert Associates, Inc. Reading, Pa.  
For primary bibliographic entry see Field 6G.  
W76-12784

#### MAP SHOWING LAKES IN THE GREATER DENVER AREA FRONT RANGE URBAN CORRIDOR, COLORADO,

Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12795

#### LAKES IN THE COLORADO SPRINGS-CASCADE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,

Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C.  
W76-12797

#### ANALYSIS OF MULTIPLE CELL MECHANICAL DRAFT COOLING TOWERS,

Pacific Northwest Environmental Research Lab., Corvallis, Oreg.  
L. R. Davis.  
Report EPA-660/3-75-039, June 1975, 38 p, 7 fig, 17 ref.

Descriptors: \*Model studies, \*Mathematical models, \*Cooling towers, \*Thermal pollution, Cooling water.

A mathematical model capable of calculating plume rise and dilution from multiple cell mechanical draft cooling towers with the wind normal to the tower line is presented. Calculation techniques are included for the zone of flow establishment, the zone of fully developed single plumes, the zone of merging multiple plumes and the zone of completely merged plumes. The entrainment functions presented include the effects of plume interference and variable entrainment surfaces on merging. Coefficients in the entrainment function must be determined from suitable field or laboratory data. The report version is for dry plumes but equations and modifications required to convert to moist plumes are included. (Chilton-ORNL)  
W76-12848

#### EFFECT OF METEOROLOGICAL VARIABLES ON TEMPERATURE CHANGES IN FLOWING STREAMS,

Pacific Northwest Environmental Research Lab., Corvallis, Oreg.  
R. W. Troxler, Jr. and E. L. Thackston.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-240 285, \$5.00 in paper copy, \$3.00 in microfiche. Report EPA-660/3-75-002, January 1975, 83 p, 24 fig, 5 tab, 5 ref, 3 append. R-800613.

Descriptors: \*Model studies, \*Mathematical models, \*Forecasting, \*Water temperature, Streams, Meteorology, Water pollution effects.

A mathematical model to be used in predicting water temperature changes in a flowing stream as a function of stream geometry and weather information was developed and tested. Measurements

were made on cold water from power stations as it warmed moving downstream over periods of up to 38 hours. Data on which the temperature changes were made were obtained from a boat floating with the water, a station on the bank and a remote weather station 100 miles away. Difficulties encountered in predicting stream temperatures with weather data from stations other than in the river valley required modifications to account for the climatological differences between the two locations. It was concluded that highly accurate weather predictions are difficult to obtain and that predictions determined by the model can only be as accurate as the weather data used for input. The model studied appears to be a useful tool. (Chilton-ORNL)  
W76-12849

#### CHARACTERISTICS OF THE TOXIC EFFECT OF PROPYLPHENOL ISOMERS AND THEIR SAFE LEVEL IN WATER BODIES, (IN RUSSIAN),

Estonskii Institut Eksperimentalnoi i Klinicheskoi Meditsiny, Tallinn (USSR).  
I. A. Veldre, K. K. Norman, and V. P. Saliev.  
Gig Sanit. 7, p 94-96, 1974.

Descriptors: \*Toxicity, \*Phenols, Rodents, Data collections, Organoleptic properties.  
Identifiers: \*Isomers, Maximum allowable concentrations, \*Propylphenol isomers, \*Perception threshold concentrations.

Data on the toxicity of p- and o-propylphenols for white mice, white rats and guinea pigs and perception threshold concentrations (PTC) are presented. The PTC for o-propylphenol was 0.01 mg/l with respect to odor before and after heating and chlorination of the water; the PTC for p-propylphenol was 0.025 mg/l with respect to odor and taste before water processing and odor after water processing. The organoleptic index of noxiousness of both isomers was the more sensitive index. The maximum allowable concentration of both isomers in water bodies is 0.01 mg/l. --Copyright 1975, Biological Abstracts, Inc.  
W76-12850

#### THE EVAPORATION AND DEGRADATION OF N-NITROSO DIMETHYL AMINE IN AQUEOUS SOLUTIONS,

Air Force Civil Engineering Center, Kirtland AFB, N. Mex.  
For primary bibliographic entry see Field 5B.  
W76-12852

#### THE ENVIRONMENTAL IMPACT OF WATER CHLORINATION,

Oak Ridge National Lab., Tenn.  
CONF-751096, Proceedings of a conference held at Oak Ridge, Tennessee on October 22-24, 1975. 443 p. Jolley, R. E., Ed.

Descriptors: \*Conferences, \*Environmental effects, \*Chlorination, \*Waste water treatment, Organic compounds, Model studies, Forecasting, Chemistry, Chlorine, \*Water treatment.

The conference was organized and conducted by members of the U.S. Environmental Protection Agency, the Energy Research and Development Administration and the Biology, Chemical Technology, and Environmental Sciences Divisions of the Oak Ridge National Laboratory. The proceedings contains 18 papers on the conference subject. The general subject areas included are aqueous chemistry of chlorine, biomedical effects of chloroorganics, environmental transport and effects, and modeling and prediction. (See W76-12877 thru W76-12895) (Chilton-ORNL)  
W76-12876

#### CURRENT CHLORINATION AND DECHLORINATION PRACTICES IN THE

**TREATMENT OF POTABLE WATER, WASTE-WATER, AND COOLING WATER.**  
For primary bibliographic entry see Field 5D.  
W76-12877

**THE CHEMISTRY OF AQUEOUS CHLORINE IN RELATION TO WATER CHLORINATION.**  
Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.  
J. C. Morris.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 27-41, 1 fig, 1 tab, 15 ref.

Descriptors: \*Chlorine, Aqueous solutions, Chemical reactions, Chemcontrol, Organic compounds, \*Waste water treatment, Forecasting, \*Chlorination, Water chemistry.

Of the variety of molecular and ionic species produced when chlorine is dispersed in water, HOCl is the dominant species. When HOCl reacts as an electrophilic reagent at oxygen, chloride ion is formed by displacement. When the reaction is at amine-N or at carbon the electrophilic attack is by the chlorine atom. Other forms of electrophilic attack are of chloramination, of chlorophenol formation or other aromatic substitution, of addition to double bonds, and of haloform formation. Thus, it was concluded that the reactions of aqueous chlorine in water chlorination follow well-defined pathways in accord with general principles of organic reaction mechanisms. Even when the exact composition of the organic material in a water or wastewater is not known, it is still possible to predict something of the nature and extent of the reactions with aqueous chlorine to be anticipated. (See also W76-12876) (Chilton-ORNL)  
W76-12878

**MEASUREMENT AND PERSISTENCE OF CHLORINE RESIDUALS IN NATURAL WATERS.**  
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.  
For primary bibliographic entry see Field 5A.  
W76-12879

**ORGANO-CHEMICAL IMPLICATIONS OF WATER CHLORINATION.**  
Minnesota Univ., Duluth. Dept. of Chemistry.  
R. M. Carlson, and R. Caple.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 73-83, 6 fig, 2 tab, 10 ref.

Descriptors: \*Environmental effects, \*Water pollution, \*Chlorine, \*Waste water treatment, Waste water, Organic compounds, \*Chlorination, Chemistry, Forecasting.

The investigation of the dilute aqueous chlorination of typical compounds known to be present in water subjected to chlorine renovation indicates that chlorine is readily incorporated into the carbon framework by a pathway that is predominantly ionic. The study considers the relationship of mechanistic processes to pH, product distribution, BOD, oxidative capacity and chloramine formation. The use of the basic principles of mechanistic chemistry provides for an element of predictability of the environmental impact resulting from the chlorination process. (See also W76-12876) (Chilton-ORNL)  
W76-12880

**CHLORINATION OF ORGANICS IN DRINKING WATER.**  
Municipal Environmental Research Lab., Cincinnati, Ohio. Water Supply Research Div.  
A. A. Stevens, C. J. Slocum, D. R. Seeger, and G. G. Robeck.

CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 85-114, 12 fig, 15 ref.

Descriptors: \*Environmental effects, \*Water pollution effects, \*Potable water, \*Water treatment, Water quality, \*Chlorination, Organic compounds, Chemistry, Public health.

Trihalomethanes, potential health hazards, are formed during the chlorination step of the water treatment process. Some factors influencing trihalomethane production (precursor compound concentration, pH, type of disinfectant used, and temperature) are investigated. The precursor to trihalomethane is identified as a complex mixture of humic substances and simple low molecular weight compounds containing the acetyl moiety. The relative importance and contribution to trihalomethane production of each of the specific precursor compounds are pH dependent. The point of chlorination in the treatment process, being a significant factor in trihalomethane production, probably represents the most important variable to be considered for change in attempts to reduce ultimate trihalomethane concentrations in finished drinking water. (See also W76-12876) (Chilton-ORNL)  
W76-12881

**CHLORINATION OF ORGANICS IN COOLING WATERS AND PROCESS EFFLUENTS.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5A.  
W76-12882

**ANALYSIS OF NEW CHLORINATED ORGANIC COMPOUNDS FORMED BY CHLORINATION OF MUNICIPAL WASTE-WATER.**  
North Texas State Univ., Denton. Inst. of Applied Sciences.  
For primary bibliographic entry see Field 5A.  
W76-12883

**CHEMISTRY OF HALOGENS IN SEAWATER.**  
Rosentiel School of Marine and Atmospheric Science, Miami, Fla.  
For primary bibliographic entry see Field 5A.  
W76-12884

**HALOGENATED ORGANICS IN TAP WATER: A TOXICOLOGICAL EVALUATION.**  
Health Effects Research Lab. Cincinnati, Ohio.  
R. G. Tardiff, G. P. Carlson, and V. Simmon.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 213-227, 7 tab, 18 ref.

Descriptors: \*Environmental effects, \*Toxicity, Chlorination, Organic compounds, Potable water, Public health, \*Halogens, Chlorine.  
Identifiers: Mutagenesis, Carcinogenesis, Teratogenesis.

Surveys revealed that approximately 34% of the organic compounds found in drinking water are halogenated and that approximately 50% of the volatiles found in drinking water are halogenated. Assessment of these compounds requires consideration of degree of exposure, intrinsic toxicity of the agents, interactions among compounds and with other environmental factors, and species sensitivity. A program aimed at the toxicologic definition of the chlorinated hydrocarbons is described. Two approaches are taken; (a) that dealing with bioscreen of mixtures or organic compounds for mutagenesis, chronic toxicity/carcinogenesis, and teratogenesis; and (b) that dealing with specific chlorinated hydrocarbons or classes of these compounds, with specific emphasis on comparative metabolism for prediction of human responses and

on interactions for predictions of synergism and antagonism. (See also W76-12876) (Chilton-ORNL)  
W76-12885

**ORIGIN, CLASSIFICATION AND DISTRIBUTION OF CHEMICALS IN DRINKING WATER WITH AN ASSESSMENT OF THEIR CARCINOGENIC POTENTIAL.**  
National Cancer Inst., Bethesda, Md.  
H. F. Kraybill.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 229-246, 5 tab, 42 ref.

Descriptors: \*Environmental effects, \*Public health, Chemicals, Potable water, Organic compounds, Chlorination, Distribution, Path of pollutants.  
Identifiers: \*Carcinogens.

Of the 235 chemicals in drinking water, 21 were characterized as having carcinogenic activity. Four of the chemicals listed are recognized carcinogens, the remaining are classified as suspect. Not all chemicals classified as having carcinogenic potential or activity can be assessed as to their equivalent hazard. Some chemicals may be characterized as potential carcinogens on the basis of structural relationships or ancillary studies on mutagenicity. The integrated insult from multiple carcinogens may have additive or inhibitory properties. The levels of the carcinogenic organics are in the parts-per-trillion and parts-per-billion range. (See also W76-12876) (Chilton-ORNL)  
W76-12886

**THE POTENTIAL FOR INCREASED MUTAGENIC RISK TO THE HUMAN POPULATION DUE TO THE PRODUCTS OF WATER CHLORINATION.**  
Oak Ridge National Lab., Tenn.  
R. B. Cumming.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 247-258, 2 tab, 11 ref.

Descriptors: Environmental effects, \*Water treatment, \*Chlorination, Potable water, Organic compounds, Chlorine, Public health, Laboratory tests.  
Identifiers: \*Mutagenesis.

A chemical (5-chlorouracil) which is known to be produced by water chlorination and to be present in drinking water was tested in several mammalian and submammalian genetic test systems. Data for incorporation studies into the DNA of mice together with specific-locus mutation data allow calculation of the upper 95% confidence limit for mutations induced in the human population at environmental exposure levels. This calculation demonstrates that the chemical in question does not, by itself, pose a significant genetic hazard to humans at current release levels. Data is not available on whether or not all of the chlorine-containing organic compounds produced by water chlorination pose a significant hazard. (See also W76-12876) (Chilton-ORNL)  
W76-12887

**THE EPIDEMIOLOGIC APPROACH TO THE EVALUATION OF WATER-BORNE CARCINOGENS.**  
National Cancer Inst., Bethesda, Md.  
K. P. Cantor.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 259-274, 3 tab, 16 ref.

Descriptors: \*Epidemiology, Water treatment, \*Environmental effects, \*Water pollution, Chemicals, Disease, Human diseases, Human populations, \*Public Health.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Identifiers: \*Carcinogens.

Epidemiologic studies are valuable because they are made directly on human populations making extrapolation from animal models and/or unrealistically high doses unnecessary in predicting effects on humans. Epidemiologic studies for cancer have limitations which include the long latent period for most cancers, difficulties in estimating dose, the definition of at-risk populations, and the relatively low exposure levels to carcinogens. The report lists a number of substances which have been identified as carcinogens (mustard gas, radiation, vinyl chloride monomer, B-Naphthylamine, benzidine, asbestos and smoking, asbestos, and cigarettes) and strongly linked to specific sites in the human body. So-called latent periods for most of the listed carcinogens are also indicated as well as the relative risk where it has been estimated. (See also W76-12876) (Chilton-ORNL)  
W76-12888

#### THE TOXICITY OF CHLORINE TO FRESHWATER ORGANISMS UNDER VARYING ENVIRONMENTAL CONDITIONS, Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.

A. S. Brooks, and G. L. Seegert.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 277-298, 66 ref.

Descriptors: \*Environmental effects, \*Toxicity, \*Chlorine, Aquatic life, Freshwater, Water pollution effects, Fish, Temperature, Water quality.  
Identifiers: Exposure time, Dose rates.

Chlorine enters freshwater systems under a wide variety of environmental conditions including wide ranges of temperature, water quality, and variable application times and dose rates. The literature is reviewed in an attempt to evaluate the influence of these variables with respect to the toxicity of chlorine to freshwater organisms. It was concluded that the response of freshwater organisms to chlorine is species dependent and that the life stage and size of an organism is an important factor in the toxicity of chlorine. Exposure time and chlorine concentrations are critical in determining the final response of organisms. Temperature effects appear to be species dependent and also dependent on the specific temperature range concerned. The avoidance of chlorine by fish was demonstrated in the laboratory. (See also W76-12876) (Chilton-ORNL)  
W76-12889

#### A REVIEW OF THE IMPACT OF CHLORINATION PROCESSES UPON MARINE ECOSYSTEMS, Gulf Breeze Environmental Research Lab., Wadmalaw Island, S.C. Bears Bluff Field Station.

W. P. Davis, and D. P. Middaugh.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 299-325, 2 fig, 3 tab, 53 ref.

Descriptors: \*Environmental effects, \*Chlorination, \*Water pollution effects, Sea water, Ecosystems, \*Reviews, Model studies.

This paper presents a theoretical degradation model of chlorine added to marine waters and summarizes the literature on laboratory investigations and ecological effects of chlorine. The theoretical degradation model progresses through five levels to stable end products (Cl<sup>-</sup> and Br<sup>-</sup>) through a diverse group of mechanisms operative in the steps. (See also W76-12876) (Chilton-ORNL)  
W76-12890

#### CHLORINATED COMPOUNDS FOUND IN WASTE-TREATMENT EFFLUENTS AND THEIR CAPACITY TO BIOACCUMULATE, Minnesota Univ., Duluth. Dept. of Chemistry.

For primary bibliographic entry see Field 5A.  
W76-12891

#### INVESTIGATING THE EFFECTS OF CHLORINATED ORGANICS, Oak Ridge National Lab., Tenn.

C. W. Gehrs, and G. R. Southworth.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 347-362, 2 fig, 2 tab, 12 ref.

Descriptors: \*Environmental effects, \*Water pollution effects, \*Chlorination, \*Organic compounds, Fish, Zooplankton, Carp, Daphnia, Mortality, Hatching, Mature growth stage.

Toxicity studies were conducted using the zooplankter *Daphnia magna* and the fish *Cyprinus carpio*. The parameters used were mortality and maturation in the zooplankter and hatching success (mortality) and malformation of fry for the fish. Two chlorinated compounds (5-chlorouracil and 4-chlororesorcinol) and a mixture of identified chlorinated organics were the chemicals tested. 5-chlorouracil caused no change in median survival times at concentration up to 1 mg/l. Both 4-chlororesorcinol and the synthetic mixture produced discernible changes in median survival times over the ranges tested. All concentrations of 4-chlororesorcinol and concentrations of 5-chlorouracil above 0.1 mg/l caused at least a 50% decrease in the number of young produced during the first seven days of free life in the zooplankter. Both 5-chlorouracil and 4-chlororesorcinol were found to have significantly lower hatching success of carp eggs at concentrations as low as 0.01 mg/l. The breakpoint of toxicity of the synthetic mixture was approximately 30 mg/l. A positive correlation has been seen between concentration of 5-chlorouracil and percent malformation in carp with a linear dose-response relationship originating at 0.5 mg/l. No similar response was found for either 4-chlororesorcinol or the synthetic mixture. (See also W76-12876) (Chilton-ORNL)  
W76-12892

#### MODELING RESIDUAL CHLORINE LEVELS: CLOSED CYCLE COOLING SYSTEMS, Industrial Environmental Research Lab., Cincinnati, Ohio.

G. R. Nelson.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 365-385, 5 fig, 4 tab, 13 ref, 2 append.

Descriptors: \*Model studies, \*Mathematical models, \*Chlorine, Cooling towers, Chlorination, Water pollution sources.  
Identifiers: Residual chlorine, Chlorine levels, Blowdown.

The mathematical model discussed in this paper predicts residual chlorine levels in cooling tower blowdown streams at any time during the chlorination cycle. Program characteristics of the general model include split stream vs no split stream chlorination, residual data feedback vs no residual data feedback, and positive vs negative demand at the end of the chlorine feed period. Split stream refers to the fraction of the recirculating water chlorinated; residual data feedback to the type of chlorine feed equipment used; and positive or negative demand to the time length of the chlorine feed period. There are eight variations to the model which apply to specific chlorination program characteristics. (See also W76-12876) (Chilton-ORNL)  
W76-12893

#### A KINETIC MODEL FOR PREDICTING THE COMPOSITION OF CHLORINATED WATER DISCHARGED FROM POWER PLANT COOLING SYSTEMS, Oak Ridge National Lab., Tenn.

M. H. Lietzke.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 387-401, 2 tab, 26 ref, append.

Descriptors: \*Model studies, \*Mathematical models, \*Forecasting, \*Chlorination, Powerplants, Chemistry, Cooling water, Path of pollutants.

The model, which is in the process of development, will contain three rate equations: the reaction of hypochlorous acid with ammonia, the reaction of hypochlorous acid with an organic amine, and the further reaction of hypochlorous acid with monochloramine. The simultaneous differential equations will be solved mathematically to give the composition of the water as a function of time. (See also W76-12876) (Chilton-ORNL)  
W76-12894

#### ASSESSING TOXIC EFFECTS OF CHLORINATED EFFLUENTS ON AQUATIC ORGANISMS: A PREDICTIVE TOOL, Oak Ridge National Lab., Tenn.

J. S. Mattice.  
CONF-751096, In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, held in Oak Ridge, Tennessee on October 22-24, 1975. p 403-422, 2 tab, 3 fig, 44 ref.

Descriptors: \*Environmental effects, \*Model studies, \*Mathematical models, \*Forecasting, \*Chlorination, Effluents, Aquatic life, \*Toxicity.

The tool proposed in this paper includes length of exposure and concentration as factors of importance and allows for protective limitations to be applied to releases on a site specific basis. Acute and chronic mortality thresholds are derived by (1) summarizing extant chlorine toxicity data in log concentration-log duration plots, (2) bounding these data points from below with straight lines to estimated acute and chronic median lethal thresholds, and (3) shifting the acute median lethal threshold to estimate a true mortality threshold using an empirically derived relationship between exposure time necessary to yield fifty and zero percent mortality. Yes or no decisions concerning mortality are derived by comparing these thresholds with dose-time exposures for entrained organisms. (See also W76-12876) (Chilton-ORNL)  
W76-12895

#### EFFECT OF THE OPERATING CONDITIONS OF RECYCLING WATER SUPPLY SYSTEMS ON THE QUALITY OF REUSED WASTE WATERS, (IN RUSSIAN), Vsesoyuznyi Nauchno-Issledovatel'skii Institut Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidroteologii, Moscow (USSR).

P. P. Markov, and M. V. Kozlova.  
Gig Sanit. 38(11), p 103-105, 1973.

Descriptors: \*Recycling, Water supply, \*Water quality, \*E. coli, Foulage, Bacteria, \*Coliforms, Operations, \*Microorganisms, \*Pathogenic bacteria, Evaporation, Temperature.  
Identifiers: \*Biological fouling, \*Saprophytes.

The main factors influencing the survival of microorganisms in recycled water (the number of times it is evaporated and temperature) were studied in an experimental plant. The magnitude of the coliform index of recycled water showed that with an increase of temperature and number of times the water is evaporated the survival rate of *Escherichia coli* decreases. The operating condi-



tions of the cooling system of the recycling water supply system stimulate the development of biological fouling of the system by bacteria due to an increase of the number of saprophytes in the recycled water in comparison with the added water, and improves the sanitary state of the recycled water as a result of reducing the survival of pathogenic microorganisms.—Copyright 1975, Biological Abstracts, Inc. W76-12907

**THE CONDUCT OF CERTAIN LONG-LIVED ISOTOPES IN ROCKS IN THE CASE OF THEIR CONTAMINATION WITH NONTECHNICAL EFFLUENTS OF THE ATOMIC ELECTRIC POWER STATIONS (AES), (IN RUSSIAN).** For primary bibliographic entry see Field 5B. W76-12908

**EFFECT OF SUSPENDED COAL PARTICLES ON LIFE FORMS OF AQUATIC MOSS EURHYNCHUM RIPARIOIDES (HEDW): II. THE EFFECT ON SPORE GERMINATION AND REGENERATION OF APICAL TIPS.** University Coll., Cardiff (Wales). Dept. of Botany. K. Lewis. Freshwater Biol. 3(4), p 391-395, 1973.

Descriptors: \*Mosses, \*Coal mine wastes, Germination, Spores, Suspended solids, Plant growth, Growth stages. Identifiers: \*Eurhynchium-Riparioides, \*Regeneration, Rhizoidal, Coal dust, Apical tips.

The aquatic moss *E. riparioides* is capable of living below the discharge from a coal washery effluent. The effect of coal dust on the reproducing powers of *E. riparioides* is described. The percentage germination of the spores of *E. riparioides* is reduced by 42% in the presence of 5000 mg/l of suspended coal particles, but with decrease in coal dust concentration, there is an increase in the amount of germination. The effect of suspended coal dust on the regeneration from detached apical tips of *E. riparioides* is discussed; rhizoidal growth occurs in every concentration of coal dust including 5000 mg/l, although the development of new side shoots is observed only in concentrations below 500 mg/l.—Copyright 1974, Biological Abstracts, Inc. W76-12913

**EFFECTS OF CHEMICAL POLLUTANTS ON TELEMEADIATORS INTERVENING IN THE MICROBIOLOGICAL AND PLANKTONIC ECOLOGY IN A MARINE ENVIRONMENT: III, (IN FRENCH).** Centre d'Etudes et de Recherches de Biologie et d'Océanographie Médicale, Nice (France). D. Pesando, and M. Aubert. Rev Int Oceanogr Med 39/40, p 109-116, (1974).

Descriptors: \*Chemical wastes, \*Microbiology, \*Plankton, Ecology, Diatoms, Pesticides, Detergents, Organic compounds, Industrial wastes, Metals, Carbon, Water pollution effects, Aquatic plants. Identifiers: \*Asterionella-Japonica, \*Peridinium trochoideum, \*Telemediators.

As part of research on the effects of chemical pollutants on telemediators affecting microbiological and planktonic microbiology, the action of chemical pollutants (hydrocarbons, detergents, pesticides, industrial wastes and metals) on a growth inhibitor of a marine diatom *Asterionella japonica* product by *Peridinium trochoideum* was studied. Some of these pollutants have a positive action on this mechanism in lower, sublethal concentrations. (See also W73-10095)—Copyright 1976, Biological Abstracts, Inc. W76-12922

**DETERGENTS, (LITERATURE REVIEW),** Missouri Univ., Columbia.

S. K. Banerji. Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1110-1115, June, 1976. 27 ref.

Descriptors: \*Detergents, \*Surfactants, \*Water pollution effects, \*Waste water treatment, \*Aquatic environment, Algae, Fish, Anions, Cations, Biological treatment, Phosphates, Carbonates, Nutrients, Phosphorus, \*Reviews, \*Bibliographies. Identifiers: Whiteners agents, \*Literature reviews.

A literature review of the effects of detergents on waste water treatment processes and the aquatic environment is presented. Topics covered include: the effects of a ban on detergent phosphates on stream nutrient levels, the effects of detergent phosphorus on the growth of different species of algae, the effects of surfactants on fish, the accumulation and elimination of detergent whitening agents in bluegill, the degradation of anionic surfactants in artificial waste water media, the effects of cationic detergents on microorganisms in biological treatment plants, and the effects of carbonate detergents on biological waste treatment. (Kreager-FIRL) W76-12925

**THE ECOLOGY OF ALGAE IN THE MORUYA RIVER, AUSTRALIA.** Bath Univ. (England). I. C. Potter, D. Cannon, and J. W. Moore. Hydrobiologia, Vol. 47, No. 3-4, p. 415-430, 1975. 6 fig, 3 tab, 24 ref.

Descriptors: \*Australia, \*Algae, Varieties, Succession, Dominant organisms, Herbivores, Seasonal, Standing crops, Benthic flora, Plankton, Diatoms, Chlorophyta, Scenedesmus, Lampreys, Ammocoetes, \*Ecology. Identifiers: \*Moruya River(Australia).

Studies of the Moruya River, Australia, indicated little scouring of the substrate. Turbidity and color were low and pH was slightly above neutral with no seasonal variation. Silicates were high. Calcium, nitrates, and silicates were seasonally static. Dissolved oxygen was always near saturation. Compared to northern hemisphere rivers, standing crops of benthic and planktonic algae were low. Diatoms always accounted for more than 90% of algae in sediments; the most common species were typical of holarctic flora. At all sampling sites, the relative abundance of the six predominant algal genera was similar. Gomphonema was more abundant downstream and Coconeis placentula upstream. The largest standing crop was downstream in the calmest part of the river from January-March, coinciding with maximum water temperatures. Downstream a true phytoplankton succession of filamentous chlorophytes, Scenedesmus, Melosira varians, Dactylococcopsis, Eudorina, and Merismopedia was observed in the spring and summer and a maximum standing crop in December. Guts of larval lampreys (larger than 100 mm) contained large numbers of algal cells. Scenedesmus and Dactylococcopsis were found more frequently in the guts than in sediment or water; however the reverse was true for filamentous algae. Ammocoetes did not appear to significantly affect the algal standing crop. (Buchanan-Davidson-Wisconsin) W76-12934

**SIGNIFICANCE OF CELLULAR NITRATE CONTENT IN NATURAL POPULATIONS OF MARINE PHYTOPLANKTON GROWING IN SHIPBOARD CULTURES.** Centre Universitaire de Luminy, Marseille (France). Laboratoire d'Océanographie. Y. Collos, and G. Slawyk. Marine Biology, Vol. 34, No. 1, p. 27-32, 1976. 1 fig, 3 tab., 32 ref.

Descriptors: \*Nitrates, \*Marine algae, \*Metabolism, \*Absorption, \*Diurnal, Cultures, Denitrification, Sea water.

Identifiers: \*Intracellular nitrate, Particulate nitrogen.

To study the significance of intracellular nitrate in controlling nitrate assimilation by marine phytoplankton and to understand relationships between nitrate uptake and reduction, phytoplankton intracellular nitrate concentrations were monitored in experiments on shipboard cultures of surface sea water from an upwelling region. Measurements were related to parameters of biomass (particulate nitrogen) and nitrate assimilation using nitrogen-15 isotope and nitrate reductase assays. Cellular nitrate was determined by filtering sea water, grinding in deionized water, centrifuging, and measuring nitrate in the supernatant in an autoanalyzer. Cellular nitrate concentrations exhibited diurnal variations (3.1-206 mg-at nitrate per microgram-at particulate nitrogen). These could be correlated positively with nitrate reductase activity. Nitrogen budgets indicated that nitrate reductase activity represented only 12% of nitrate incorporation in organic phytoplankton material when nitrate was present in sea water. When environmental nitrate was depleted (zero uptake), nitrate reductase activity completely accounted for internal nitrate decrease. Internal nitrate contents were better indices of nitrate consumption by marine phytoplankton than external nitrate-nitrogen concentrations, since no quantitative relationship was found between sea water nitrate and nitrate reductase activity. Diurnal variations in metabolism may be as important in phytoplankton competition and succession as temporal variations of environmental parameters. (Buchanan-Davidson-Wisconsin). W76-12936

**LAKE GEORGE SITE SYNTHESIS, 1974-1975.** Rensselaer Polytechnic Inst., Troy, N.Y. Fresh Water Inst. N. L. Clesceri, C. W. Boylen, D. C. McNaught, L. S. Clesceri, and R. A. Park. Report FWI 75-15 (EDFB 75-7), (1975). 16 p. 20 ref. NSF BMS 69-01147 A09.

Descriptors: \*Computer models, \*Lakes, \*Primary productivity, \*Secondary productivity, Research and development, Rooted aquatic plants, Degradation(Decomposition), \*New York, Predation, Crustaceans, Algae, Grazing, Zooplankton, Fish, Cycling nutrients. Identifiers: \*Lake George(NY), Model CLEAN, Model CLEANER.

Synthesis activities at the Lake George site during 1974-1975 are reviewed. Primary productivity modeling centered on development and implementation of a submodel to estimate rooted macrophyte productivity, which permitted input of data not previously accessible by the submodel WEED. To measure secondary productivity, a resource allocation-predation model was rebuilt, calibrated, and validated for herbivorous crustaceans. Selective grazing on natural algal assemblages by zooplankton was studied and a technique developed to examine size-selective grazing. The resource allocation-predation model permits assessment of effects of predator populations on zooplankton production in Lake George or other oligotrophic-mesotrophic lakes. The model suggests the importance of selective predation in regulating zooplankton production. Laboratory studies of selective feeding helped understand mechanisms of selective grazing. The glucose assimilatory activity of water columns and sediments was measured. Conversion factors were developed to give data collected during decomposition more ecological realism and make it more useful for models. Synthesis efforts resulted in validation, documentation, and evaluation of sensitivity of the models CLEAN and CLEANER. The model is valid for mesotrophic and eutrophic conditions, but is too sensitive to changes in certain parameters, so further modeling should focus on representation of adaptive shifts in environmental response. (Buchanan-Davidson-Wisconsin). W76-12937

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

**FLUCTUATIONS OF PHYTOPLANKTON BIOMASS AND ITS COMPOSITION IN A SUB-ARCTIC LAKE DURING SUMMER,**  
Toronto Univ. (Ontario). Dept. of Botany.  
R. G. Sheath, M. Munawar, and J. A. Hellebust.  
Canada Journal of Botany, Vol. 53, p. 2240-2246. 2 fig., 1 tab., 22 ref.

Descriptors: \*Fluctuations, \*Phytoplankton, \*Biomass, \*Subarctic, \*Lakes, Canada, Summer, Chlorophyta, Diatoms, Dominant organisms, Algae, Succession, Dinoflagellates, Varieties, Nannoplankton, Benthic flora, Chrysophyta.  
Identifiers: Norman Wells(N.W.T.), Subarctic lakes.

Phytoplankton fluctuations, succession of algal taxa, net plankton, and nannoplankton, and comparisons of phytoplankton and benthic algae were studied in a small subarctic lake located near Norman Wells, Northwest Territories, Canada. During the ice-free period, phytoplankton biomass increases were observed; peaks were observed early in July and late in August. Chlorophyta and Diatomaceae were dominant during periods of high biomass; this was not due to wind stirring of benthic forms. Other algal groups only showed relative increases during the minima. The early summer population was almost entirely diatoms, followed by mixed populations of diatoms and cryptomonads; Chlorophyta were dominant in midsummer; and then there were successive increases in chrysomonads, dinoflagellates, and finally diatoms. Fluctuations in major species were studied in relation to changes in algal group biomasses. Net plankton species were dominant (accounted for more than 50% of the total) most of the summer. Nannoplankters were only abundant for short periods from mid-June to July. Phytoplankton species composition in July was dissimilar to that of benthic algae, since only 15% of the species were common to both habitats and these species contributed to 23% of the estimated phytoplankton biomass. The source of common species is not known. (Buchanan-Davidson-Wisconsin)  
W76-12938

**ULTRASONIC REMOVAL OF EPILITHIC ALGAE IN A BARCLAMP SAMPLER,**  
Ichthyological Associates, Inc., Berwick Pa.  
For primary bibliographic entry see Field 5A.  
W76-12939

**AN AUTOMATED ASSAY FOR THE DETERMINATION OF NITRATE REDUCTASE IN MARINE PHYTOPLANKTON,**  
Centre Universitaire de Luminy, Marseille (France). Laboratoire d'Océanographie.  
G. Slawyk, and Y. Collos.  
Marine Biology, Vol. 34, No. 1, p. 23-26, 1976. 5 fig., 13 ref.

Descriptors: \*Denitrification, \*Analytical techniques, \*Marine algae, \*Assay, Metabolism, Enzymes, Nitrites, Nitrates, Automation, \*Bioassay, \*Pollutant identification.  
Identifiers: \*Nitrate reductase.

An automated assay was developed to determine nitrate reductase activity in marine phytoplankton. This enzyme can be used as an index of the rate of nitrate-nitrogen assimilation in phytoplankton. The enzymes were extracted manually with phosphate buffer from cells in seawater, but the successive steps of substrate addition, incubation, stopping of the reaction, adding of reagents for nitrate measurement, and absorbance reading were done automatically using a Technicon AutoAnalyzer. This was compared with a manual method, using samples from the euphotic zone and shipboard cultures. Results obtained with the two methods were in good agreement; a correlation coefficient of 0.96 was calculated from the data. The automated method can handle up to twenty samples an hour, thus helping to overcome the dif-

ficulty of making frequent observations when studying diurnal variations of phytoplankton metabolic activities. It permitted the simultaneous handling of other measurements when enzyme extraction was completed. Results should also be more reproducible. Nitrate reductase activity and changes in nutrient concentrations, biomass, and assimilation rates were measured over a 14-hour period in shipboard cultures and in diatom batch cultures. (Buchanan-Davidson-Wisconsin)  
W76-12940

**THE INFLUENCE OF GIBBERELLIC ACID AND KINETIN ON THE GROWTH OF SCENEDESMUS QUADRICAUDA (TURP.) BREV.,**  
Wroclaw Univ. (Poland). Dept. of Experimental Botany.  
J. Buczek, G. Kubik-Dobosz, and E. Tatkovska.  
Acta Societatis Botanicorum Poloniae, Vol. 44, No. 3, p. 415-421, 1975. 3 tab, 12 ref.

Descriptors: \*Algae, \*Scenedesmus, \*Growth rates, Proteins, Cultures, Biomass.  
Identifiers: \*Hormones, \*Gibberellic acid, \*Kinetin.

The influence of gibberellic acid and kinetin (6-furfurylamino purine) on *Scenedesmus quadricauda* growth was studied. Gibberellic acid (0.000001 M) significantly increased algal dry weight after 6 and 12 days growth, but not after 18 days; it had no effect on protein content; and increased the number of cells after 6 and 12 days, but not after 18 days. Kinetin (0.000001 and 0.000001 M) increased dry weight about 22% after 12 days, and increased the protein content, especially during the initial phase of algal growth. Kinetin (0.000001 M) increased cell multiplication on all days by more than 30% and caused significant increases in cell division rates throughout the culture period. The lower kinetin concentration enhanced cell division after 12 days culture and prolonged intensive algal growth. The presence of these substances was not necessary for *Scenedesmus* growth. Gibberellic acid only stimulated cell multiplication and dry weight during the intensive growth phase; after that stage the mass and quantity of cells were the same as controls. Kinetin only affected cell division during the initial growth stage; affected dry weight after 12 days; and prolonged the ability of the cells to divide, thus extending the intensive growth phase. (Buchanan-Davidson-Wisconsin)  
W76-12941

**EFFECT OF ENVIRONMENTAL FACTORS ON PHOTOSYNTHESIS PATTERNS IN PHAEODACTYLUM TRICORNUTUM (BACILLARIOPHYCEAE). I. EFFECT OF NITROGEN DEFICIENCY AND LIGHT INTENSITY,**  
University Coll. London (England).  
H. Glover, J. Beardsall, and I. Morris.  
Journal of Phycology, Vol. 11, No. 4, p. 424-429, 1975. 1 fig, 7 tab, 16 ref.

Descriptors: \*Biochemistry, \*Marine algae, \*Photosynthesis, \*Diatoms, \*Carbon, \*Nitrogen, \*Light intensity, Absorption, Deficient elements, Measurement, Amino acids, Carbon dioxide, Environmental effects.  
Identifiers: \*Phaeodactylum tricornutum, Carbon fixation.

During short-term carbon-14-carbon dioxide photoassimilation in cultures of the marine diatom *Phaeodactylum tricornutum*, much of the total fixed carbon was incorporated into amino acids and amides. Increasing nitrogen limitation in a nitrogen-limited chemostat affected radioactivity distribution in individual compounds but had no significant effect on the proportion of carbon incorporated into amino acids and amides together. Increased nitrogen deficiency reduced the proportion incorporated into amides, reduced the proportion of alanine, increased the amount of glutamic

acid, increased the proportion of carbon assimilated into tricarboxylic acid cycle intermediates, and decreased the relative synthesis of sugar phosphates. Reduced light intensities did not significantly affect the proportion of carbon incorporated into total amino acids and amides, but decreased the radioactivity assimilated into glycine and serine and increased that assimilated into alanine. It is possible that the incubation time was too long and the products were secondary products or that carboxylation of C-3-compounds to C-4-carboxylic acids of the tricarboxylic acid cycle was more important in *Phaeodactylum* than other algae. The significance of the facts that reduced light intensities and increased nitrogen deficiency did not change the relative carbon incorporation into combined amino acids and amides but caused changes in the relative importance of certain compounds is discussed. (Buchanan-Davidson-Wisconsin)  
W76-12942

**WATER QUALITY INVESTIGATIONS IN A SMALL ARTIFICIAL RESERVOIR,**  
Arkansas Dept. of Commerce, Little Rock. Div. of Soil and Water Resources.  
J. W. Moore.  
Report July 1973. 166 p, 105 fig, 2 ref, 16 append.

Descriptors: \*Physical properties, \*Water quality, \*Chemical properties, \*Reservoirs, \*Biological communities, \*Arkansas, Dissolved oxygen, Water supply, Alkalinity, Iron, Biochemical oxygen demand, Manganese, Carbon dioxide, Intakes, Nitrogen, Hardness(Water), Algae, Odor, Taste, Outlets, Reaeration, Hydrogen ion concentration, Specific conductivity, Water temperature, Flood control, Water treatment.  
Identifiers: Prairie Grove Lake(Ark), Illinois River(Ark), Blair Creek(Ark).

Selected water quality parameters were monitored over a three year period on Prairie Grove Lake, a small impoundment on Muddy Creek Fork of the Illinois River near Prairie Grove, Arkansas. Periods of zero dissolved oxygen in lower elevations of such reservoirs can be expected in this area, which vary in duration with reservoir depth and ambient air temperature. During these periods high iron and manganese concentrations can be troublesome; they are not high enough to cause rejection of the raw water source, but require consideration in water intake and treatment facility design. Algal growth may cause periodic taste and odor problems. Feasibility of installing a shroud around the outlet structure so that surplus water can be withdrawn from lower elevations in the reservoir should be considered. Withdrawal of water with low or zero dissolved oxygen concentrations would cause movement of water with higher dissolved oxygen concentrations toward the bottom. If dissolved oxygen levels can be maintained in deeper water, iron and manganese would be prevented from returning to solution. Dissolved oxygen concentrations downstream from the discharge point should be studied to determine if artificial reaeration is needed to insure sufficient dissolved oxygen for aquatic life and to satisfy water quality requirements. (Buchanan-Davidson-Wisconsin)  
W76-12943

**A PROCEDURE FOR ESTIMATING GROSS PRODUCTION, NET PRODUCTION, AND ALGAL CARBON CONTENT USING 14C,**  
S. Buckingham, C. J. Walters, and P. Kleiber.  
Verhandlungen Internationale Vereinigung Limnologie, Vol. 19, Part I, p. 32-38, 1975. 3 fig, 1 tab, 6 ref.

Descriptors: \*Equations, \*Primary productivity, \*Estimating, \*Carbon, Carbon radioisotopes, Kinetics, Respiration, Biomass, \*Productivity, Model studies.  
Identifiers: \*Carbon 14.

A model of C-14 activity in algal cells during closed incubations was developed using basic kinetic theory and taking dose rate and recycling by respiration into account. The model suggests that short experiments may estimate gross production rate, but long incubation times should not estimate net production rate. An alternative estimation procedure, involving several measurements of time of net uptake and using an estimate of algal carbon content, is proposed to estimate both gross and net production rates. If net production is low, this procedure can also be used to estimate algal biomass. The method depends on relatively high respiration to biomass ratios. When the method was tested in the laboratory using algal cultures under constant light and temperature, a clear exponential trend was observed as predicted by the model and there was no change in rate of approach to equilibrium with increased dose rate. Biomass estimates compared favorably with direct estimates from cell counts. The method appeared to work but field tests are necessary. Diurnal variations in the transport rate constants may make a more complex model necessary, but the same basic kinetic principles will still apply. (Buchanan-Davidson-Wisconsin)

W76-12944

#### SOME ECOLOGICAL ASPECTS OF THE CABORA BASSA DAM,

Rhodes Univ., Grahamstown (South Africa). Inst for Freshwater Studies.

For primary bibliographic entry see Field 6G.

W76-12945

#### THE NUTRIENT COMPOSITION, DYNAMICS, AND ECOLOGICAL SIGNIFICANCE OF DRIFT MATERIAL IN THE RED CEDAR RIVER,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.

N.R. Kevern, and R.C. Ball. Available from the National Technical Information Service, Springfield, VA 22161 as PB-242 114, \$4.50 in paper copy, \$3.00 in microfiche. Institute of Water Research, East Lansing, Technical Report No. 6, Red Cedar River Series (MSU-IWR-TR-69-0006), December 1969. 68 p. 14 fig., 15 tab., 4 ref.

Descriptors: \*Nutrients, \*Streams, \*Energy budget, \*Aquatic drift, \*Measurement, \*Michigan, \*Seston, Chemical properties, Bed load, Organic matter, Streamflow, Phosphorus, Nitrogen, Tripton, Biological properties, Sampling, Diatoms, Ecology.

Identifiers: \*Red Cedar River(Mich). \*Drift material(Streams).

Drift material in the Red Cedar River, Michigan, was qualitatively and quantitatively evaluated. Drift weights were highest during warm-water periods upstream with greater concentrations downstream in winter. Drift increased with increasing depth; bed load samples had the greatest concentrations. Drift organic matter decreased toward the bottom. Increase in stream discharge was the greatest single factor causing increase in drift concentration. Peak amounts of drift weight and phosphorus were found during the rise of water level rather than during peak flow rates. Discharge and runoff effects were less pronounced in early spring when the ground was frozen. Drift concentrations were low in winter, but drift organic matter was high. Phosphorus concentration was largely a function of drift weight, organic nitrogen was greater than phosphorus. Total annual phosphorus flow was about 12.6 metric tons with drift material contributing 2.5%. Most of the 265 metric tons of annual drift movement consisted of tripton. Drift of bottom fauna contributed 416 kg to the stream's food web. There were 192-3549 diatoms/ml which amounted to an estimated movement of 634 metric tons. Drift material was only a small amount of the annual movement of total solids and much less than dissolved components. (Buchanan-Davidson-Wisconsin).

W76-12946

#### AN ESTIMATION OF TOTAL PRODUCTION OF PLANKTONIC COPEPODS IN NERITIC ZONE OF THE GOLFE DULON (BANYULS-SUR-MER): I. QUANTITATIVE ANNUAL VARIATION, (IN FRENCH),

Arago Lab., Banyuls-sur-Mer (France).

C. Razouls.

Vie Milieu Ser B Oceanogr. 24(2), p 257-280, 1974.

Descriptors: \*Copepods, \*Plankton, Aquatic animals, \*Reproduction, Neritic, Variability, Productivity, Sampling.

Identifiers: Banyuls-Sur-Mer, France, Hensen nets, \*Neritic zone.

The cycles of numerical variation of planktonic copepods sampled with 2 Hensen nets of different mesh size (0.330 and 0.160 mm) are very similar although the feeding capacity of one is much higher than that of the other. Total numbers follow a cycle characterized by the alternation of distinct minima and maxima which result from the successions of generations of dominating species. Periods of abundance correspond to the following months: Jan.-Feb., March-April, May-June, Sept.-Oct. The minima occur in Aug. and Dec. The amplitude of the mean quantitative annual variation varies from 18,500 (or 930/m<sup>3</sup>) to 142,400 (or 7120/m<sup>3</sup>) copepods/haul (i.e., 0.41 m<sup>2</sup> surface) in the neritic province.—Copyright 1976, Biological Abstracts, Inc.

W76-12954

#### STUDIES ON A PURIFIED DIET OF PRAWN: IV. EVALUATION OF PROTEIN, FREE AMINO ACIDS AND THEIR MIXTURE AS NITROGEN SOURCE, (IN JAPANESE),

Kagoshima Prefecture Fisheries Experimental Station (Japan).

Deshimaru, Kuroki, Katsunobu, and Osamu.

Bull Jpn Soc Sci Fish. 41(1), p 101-104, 1975.

Descriptors: \*Amino acids, \*Nitrogen, \*Proteins, Fish diets, Growth rates, Mortality, Water pollution effects.

Identifiers: Penaeus-Japonicus, \*Prawns.

Prawns, *Penaeus japonicus*, were kept on purified test diets, which contained caseinalbumin (10:1), amino acids and their mixture as a N source for 4 wk. The level of the N source was 50, 37.5 and 25% for the protein and amino acid test diet, and 50% for diets containing a mixture of protein and amino acids. The best growth was obtained with the diet containing protein at a 50% level, followed by diets containing protein at 37.5% and 25% levels. The diets containing only amino acids brought about a very poor growth, low feed intake and high mortality, regardless of their levels in diets. Increase in the rate of protein to amino acids in the N source improved growth and feed intake and lowered mortality, suggesting that free amino acids are far inferior to protein as N source for prawn. (See also W72-11242 and W72-11241) — Copyright 1975, Biological Abstracts, Inc.

W76-12992

#### NORTH CAROLINA MARINE ALGAE. VI. SOME CERAMIALES (RHODOPHYTA), INCLUDING A NEW SPECIES OF DIPTEROSIPHONIA,

Duke Univ., Durham, N.C. Dept. of Botany.

C. W. Schneider.

Journal of Phycology, Vol 11, No 4, p 391-396, 1975. 7 fig, 19 ref. NSF GB-17545, CB-27725, CG-00005.

Descriptors: \*North Carolina, \*Marine algae, \*Rhodophyta, Temperate, Speciation, Distribution, Systematics, \*Diptera, Bays.

Identifiers: \*Ceramiales, Delesseriaceae, Dasyaceae, Rhodomeleaceae, Acrosorium uncinatum, Mesothamnion boergeseni, Rhododictyon bermudensis, Dasya ocellata, Dasyopsis spinuligera, \*Dipterosiphonia reversa, \*Onslow Bay(NC).

Previous studies of the offshore benthic algae in Onslow Bay, North Carolina, recorded as new fifteen taxa of Ceramiales, including three new species. An additional six Ceramiales have now been found in this area for the first time: Delesseriaceae—*Acrosorium uncinatum*; Ceramiales—*Mesothamnion boergeseni* and *Rhododictyon bermudensis*; Dasyaceae—*Dasya ocellata* and *Dasyopsis spinuligera*; and Rhodomeleaceae—*Dipterosiphonia reversa*. *Acrosorium uncinatum* and *Dasya ocellata* have frequently been reported in warm seas, but their range also extends into cool temperate waters. Previously *Mesothamnion boergeseni* was only known in Brazil. *Dipterosiphonia reversa* is added to algal literature for the first time. Evidence is also given for reassignment of *Rhododictyon bermudensis* from Dasyaceae to Ceramiales. Descriptions are presented for each, along with its known distribution, and locations of the places where it has been collected. (See also W75-10087 and W74-03885) (Buchanan-Davidson-Wisconsin)

W76-13025

#### ENERGY DEVELOPMENT: THE ENVIRONMENTAL TRADEOFFS. VOLUME 3: RELATIVE ENVIRONMENTAL RANKING OF PROPOSED OFFSHORE CONTINENTAL SHELF AREAS ON THE BASIS OF IMPACTS OF OIL SPILLS,

Stanford Research Inst., Menlo Park, Calif.

For primary bibliographic entry see Field 6G.

W76-13039

#### PUBLIC EVALUATION OF WATER QUALITY AND ITS IMPACT ON RECREATION: A CASE FROM IOWA,

Waterloo Univ., (Ontario). Dept. of Geography.

For primary bibliographic entry see Field 5G.

W76-13050

#### THERMAL LOADING OF HYCO LAKE, NORTH CAROLINA—THE EFFECT OF HEATED WATER ON TEMPERATURE AND EVAPORATION, 1966-74,

Geological Survey, Raleigh, N. C.

G. L. Giese.

Available from the National Technical Information Service, Springfield, Va 22161 as PB-254 989, \$4.50 in paper copy, \$3.00 in microfiche. Water-Resources Investigations 76-48, May 1976. 46 p, 15 fig, 12 tab, 7 ref.

Descriptors: \*Reservoir evaporation, \*Thermal powerplants, \*Water loss, \*Water temperature, \*Thermal stress, Data collections, Hydrologic budget, Mass transfer, Correlation analysis, \*North Carolina, \*Thermal pollution.

Identifiers: \*Hyc0 Lake(NC).

Between May 1966 and December 1974, four phases of thermal loading from three steam-electric generators have resulted in higher temperatures and increased evaporation from Hyc0 Lake, a 4,350 acre reservoir in north-central North Carolina. Average thermal loads during phases 1-4 were, respectively, 1.1, 2.6, 2.9, and 3.9 trillion British thermal units per month. Average monthly surface temperature increases during phases 1-4 were 2.4, 5.1, 5.0, and 5.8 degrees Fahrenheit, while average monthly forced evaporation was 2.9, 8.0, 8.4, and 9.9 cubic feet per second, respectively. These values compare with an average annual natural lake surface temperature of 62.5 degrees Fahrenheit and average annual natural evaporation of 37 inches or 18.4 cubic feet per second. (Woodard-USGS)



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

W76-13078

**A PRELIMINARY ASSESSMENT OF THE ENVIRONMENTAL VULNERABILITY OF MACHIAS BAY, MAINE TO OIL SUPERTANKERS.**  
Massachusetts Inst. of Tech., Cambridge.  
For primary bibliographic entry see Field 6G.  
W76-13087

**THE POTENTIAL EFFECTS OF INCREASING OIL TANKER SIZE ON NARRAGANSETT BAY. AN ADVISORY REPORT TO THE COASTAL RESOURCES MANAGEMENT COUNCIL.**  
Rhode Island Statewide Planning Program, Providence.  
For primary bibliographic entry see Field 6G.  
W76-13088

**POSSIBLE EFFECTS OF CONSTRUCTION AND OPERATION OF A SUPERTANKER TERMINAL ON THE MARINE ENVIRONMENT IN THE NEW YORK BIGHT.**  
State Univ. of New York at Stony Brook. Marine Sciences Research Center.  
For primary bibliographic entry see Field 6G.  
W76-13089

**ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA. VOLUME I.**  
Resource Planning Associates, Inc., Cambridge, Mass.  
For primary bibliographic entry see Field 5G.  
W76-13090

**ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA. VOLUME II. METHODOLOGY APPENDICES.**  
Resource Planning Associates, Cambridge, Mass.  
For primary bibliographic entry see Field 5G.  
W76-13091

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. I. CHANGES IN THE PHOTOCHEMICAL ACTIVITIES.**  
Marburg Univ. (West Germany). Botanisches Institut.  
G. Kulandaivelu, and H. Senger.  
Physiologia Plantarum, Vol. 36, No. 2, p 157-164, 1976. 10 fig, 1 tab, 21 ref.

**Descriptors:** \*Inhibition, \*Photosynthesis, \*Aging(Biological), \*Algae, \*Plant physiology, \*Scenedesmus, Cultures, Biochemistry, Kinetics, Fluorescence, Pollutant identification.  
**Identifiers:** \*Photochemical activity.

Changes in photosynthetic electron transport reactions in heterotrophic cells aging under the nutrient deficient conditions were studied. When the eucaryotic, unicellular green alga, *Scenedesmus obliquus*, was grown heterotrophically for 10 and 30 days without the addition of fresh media, there was an 85% and 98% loss in photosynthetic capacity, respectively, and an increase in quantum requirement. No changes in pigment amounts and types could be found that would explain the decay in photosynthetic capacity. Partial reactions mediated by photosystems I and II showed a more or less constant decay period over a 30-day period. Photosystem II reactions were less stable (decaying by 95%) than photosystem I reactions (decaying by 70%) over the 30-day period. Comparative studies of the potential of aged cells for cytochrome f photooxidation, fluorescence kinetics, 520 nm absorbance changes and the variable influence of 3-(3,4-dichlorophenyl)-1,1-dimethylurea and 2,5-dibromo-3-methyl-6-isopropyl-p-benzoquinone on the photosynthetic capacity of aged cells suggested that cells have the inherent ability to photooxidize plastoquinone (which is primarily affected). Secondary changes were also observed in the activity of reactions on the water-splitting side of photosystem II and in the P700-plasto-cyanin-cytochrome f complex. (See also W76-13110 and W76-13111) (Buchanan-Davidson-Wisconsin)

gested that cells have the inherent ability to photooxidize plastoquinone (which is primarily affected). Secondary changes were also observed in the activity of reactions on the water-splitting side of photosystem II and in the P700-plasto-cyanin-cytochrome f complex. (See also W76-13110 and W76-13111) (Buchanan-Davidson-Wisconsin)  
W76-13109

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. II. CHANGES IN ULTRASTRUCTURE AND PIGMENT COMPOSITION.**  
Marburg Univ. (West Germany). Botanisches Institut.  
G. Kulandaivelu, and H. Senger.  
Physiologia Plantarum, Vol. 36, No. 2, p 165-168, 1976. 5 fig, 18 ref.

**Descriptors:** \*Plant physiology, \*Aging(Biological), \*Cytological studies, \*Photosynthesis, Cultures, \*Scenedesmus, \*Pigments, Chlorophyll, Respiration, Pollutant identification, Electron microscopy.  
**Identifiers:** Chloroplasts, Thylakoid membranes.

Ultrastructural changes in chloroplasts which accompany loss of photosynthetic activity during ageing of heterotrophic *Scenedesmus* cells were studied by electron microscopy. Chloroplasts of actively dividing cells contained many starch grains surrounded by condensed thylakoid membrane layers. Starch grains gradually disappeared and more definite chloroplast structures formed. Later the cytoplasm became less structured and more granular; large vacuoles engulfed many organelles; and chloroplasts became more prominent. Photodensitometric analysis showed that thylakoids were very thin in dividing cells; stacking of membranes was observed during initial ageing; and thickness had increased 30% by 30 days. Total chlorophyll increased on the basis of culture volume and somewhat on the basis of cell numbers for 5 days, then remained constant. Initially the chlorophyll a/b ratio decreased rapidly. Most mitochondria degenerated and were engulfed by vacuoles. Endogenous respiration decreased slowly during ageing. Prolonged growth under heterotrophic conditions caused rapid loss of photosynthetic capacity but no observable disintegration of membrane structures. Results indicated the presence of an intact pigment system, even in aged cells, and that the loss of photosynthetic capacity is largely due to partial inactivation of the reoxidation capacity of the plastoquinone, the cytochrome f-plastocyanin-P700 complex, and the water oxidizing enzymatic reaction. (See also W76-13109 and W76-13111) (Buchanan-Davidson-Wisconsin)  
W76-13110

**CHANGES IN THE REACTIVITY OF THE PHOTOSYNTHETIC APPARATUS IN HETEROTROPHIC AGEING CULTURES OF SCENEDESMUS OBLIQUUS. III. RECOVERY OF THE PHOTOSYNTHETIC CAPACITY IN AGED CELLS.**  
Marburg Univ. (West Germany). Botanisches Institut.  
G. Kulandaivelu, and H. Senger.  
Physiologia Plantarum, Vol. 36, No. 2, p 169-173, 1976. 7 fig., 11 ref.

**Descriptors:** \*Algae, \*Photosynthesis, \*Plant physiology, \*Scenedesmus, Cultures, \*Aging(Biological), Light intensity, Magnesium, Manganese, Chlorophyll, Kinetics, Pollutant identification.  
**Identifiers:** Photooxidation, Electron transport.

When dark grown *Scenedesmus obliquus* cultures aged 2 to 30 days were transferred into light for two hours, photosynthetic capacity reactivated 1.5

to 80 fold. During reactivation, cell numbers in the packed cell volume did not increase. The reactivation rate was faster when magnesium and manganese ions were added, but addition of only fresh medium to aged cultures in the dark had little effect on photosynthetic rate. Cell growth and cell division were not observed during reactivation. Light-dependent reactivation showed biphasic (initial rapid and second slow) increases in 2 to 10-day-old cultures. The initial phase might be due to rapid reactivation by magnesium and manganese ions and the second phase to activation of protein synthetic mechanism. The action spectrum of the reactivation process had the same absorption spectrum as chlorophyll in vivo, indicating the reaction's energy dependence on photosynthesis. Kinetics of cytochrome f photooxidation, 520 nm absorbance changes, and fluorescence induction showed that immediate recovery of photosynthetic capacity was largely due to reestablishment of a balanced electron transport system. Light periods of 30 to 60 minutes were enough to reestablish efficient coupling between the two photosystems. No increase in the cytochrome f pool level (measured by light-induced absorption change) was observed during the reactivation period. (See also W76-13109 and W76-13110) (Buchanan-Davidson-Wisconsin)  
W76-13111

**INPUTS OF PHOSPHORUS FROM PRECIPITATION TO LAKE MICHIGAN.**  
DePaul Univ., Chicago, Ill.  
For primary bibliographic entry see Field 5B.  
W76-13112

**EFFECTS OF CHLORINE AND SULFITE REDUCTION ON LAKE MICHIGAN INVERTEBRATES.**  
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.  
A. M. Beeton, P. K. Kovacic, and A. S. Brooks.  
Report EPA 600-3-76-036, April 1976. 130 p. 21 fig., 5 tab., 87 ref., 3 append. R-801035-01.

**Descriptors:** \*Water pollution treatment, \*Chlorine, \*Lake Michigan, \*Benthos, \*Toxicity, \*Reduction(Chemical), Sewage treatment, Wisconsin, \*Invertebrates, Effluents, Rotifers, Copepods, Chlorination, Lethal limit, Water pollution effects.  
**Identifiers:** \*Sodium sulfite, Keratella cochlearis, Cyclops bicuspidatus thomasi.

Effects of chlorinated effluents from the Jones Island Sewage Treatment Plant on invertebrates in the Milwaukee Harbor and adjacent Lake Michigan were studied. Benthic organisms populations were reduced by the effluent plume. Measurable chlorine residuals were confined to a very small area around the effluent. The rotifer *Keratella cochlearis* and copepod *Cyclops bicuspidatus thomasi* were very sensitive to chlorine residuals. Sodium sulfite is an efficient inexpensive chemical for reducing chlorine residuals. It is not toxic to *Cyclops* or *Keratella* at levels which reduce chlorine residuals in sewage, and reduces residual chlorine toxicity effectively without producing undesirable by-products. Complete reduction occurs in less than 20 seconds. Chlorine application rates to sewage should be regulated in terms of chlorine demand of the sewage and receiving waters to minimize chlorine residuals in the effluent plume. To protect sensitive species, total residual chlorine levels should not exceed 0.002 mg/l when applied continuously. Chlorine residuals should be reduced by sodium sulfite when residual cannot be maintained within acceptable limits and where a continuously chlorinated effluent would adversely affect aquatic organisms. Studies should be made to determine if other chlorinated products are present which may not be detectable as residual chlorine yet are toxic. (Buchanan-Davidson-Wisconsin)  
W76-13113

**PHYSIOLOGICAL CHANGES DURING THE COURSE OF BLOOMS OF APHANIZOMENON FLOS-AQUAE**, Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst. F. P. Healey, and L. L. Hendzel. Journal of the Fisheries Research Board of Canada, Vol. 33, No. 1, p. 36-41, 1976 3 fig., 2 tab., 21 ref.

Descriptors: \*Plant physiology, \*Nuisance algae, \*Mortality, Plant populations, Growth rates, Laboratory tests, On-site tests, Metabolism, Cytological studies, Lakes, \*Canada, Nutrients, Trophic level, Nitrogen, Phosphorus, Nutrient requirements, Deficient elements. Identifiers: \*Aphanizomenon flos-aquae, Erickson-Elphinstone Area (Manitoba).

To determine how physiological characteristics of algal populations change during blooms and how bloom growth compared to laboratory cultures, Aphanizomenon flos-aquae cellular composition and metabolism were measured during four blooms in three prairie lakes in the Erickson-Elphinstone area, Manitoba, Canada. Change in cellular composition and metabolism were larger than in water nutrients so were more sensitive indicators of bloom progress. Initially there was a period of exponential growth corresponding to the highest protein:carbohydrate ratio; high ribonucleic acid, chlorophyll, nitrogen, and phosphorus contents; and lowest nitrogen and phosphorus debts. As growth continued, this position reversed except in one lake. There were no significant trends in ambient nutrient concentrations, despite bloom growth and large cell nutrient changes. All parameters underwent large changes during blooms, but none is a useful indicator of impending bloom collapse. Characteristics of nutrient deficiency were well-developed before each collapse, but neither indicators of impending collapse nor factors triggering collapse were identified. All blooms showed characteristics of phosphorus deficiency and, to a lesser extent, nitrogen deficiency. Despite similar characteristics, three blooms collapsed dramatically, one did not. Phosphorus deficiency was important in establishing conditions for collapse, but was not the factor triggering collapse. (Buchanan-Davidson-Wisconsin) W76-13114

**POSSIBLE EFFECT OF LOWER PHOSPHORUS CONCENTRATIONS ON THE PHYTOPLANKTON IN ONONDAGA LAKE, NEW YORK, U.S.A.**, State Univ. of New York at Buffalo. Dept. of Biology. P. Sze. Phycologia, Vol. 14, No. 4, p. 197-204, 1975. 4 fig., 1 tab., 23 ref. FWQA 11060 FAW.

Descriptors: \*Environmental effects, \*Phosphorus, \*Succession, \*Phytoplankton, \*New York, Eutrophication, Nutrient removal, Lakes, Salinity, Monitoring, Water pollution, Cyanophyta, Chlorophyta, Diatoms, Silica, Biomass, Water pollution effects. Identifiers: \*Onondaga Lake (NY), Phosphorus load.

Onondaga Lake, one of the most polluted lakes in New York, receives municipal wastes from the Syracuse area and industrial wastes containing high metal and chloride concentrations. These, with natural salt springs, give the lake a high saline content. Lake conditions were studied in 1969 and have been monitored since. Banning of phosphorus-containing detergents in 1971-1972 caused approximately a 50% reduction in inorganic phosphorus in Onondaga Lake. Disappearance of blue-green algae from summer plankton beginning in 1972 appeared related to changes in phosphorus concentration. Before 1972, flagellates and diatoms were common in the spring; during the summer, green and blue-green algae were

dominant; enough nitrogen and phosphorus were present to support the observed phytoplankton growth; and silica was depleted during diatom blooms. From 1972-1974, green algae were present in large numbers throughout the summer, and blue-green algae were absent or rare. This absence of blue-green algae probably did not result from direct growth limitation by low phosphorus levels. Reduction of pollutants entering the lake is expected to change the relative importance of phytoplankton populations without a decline in overall biomass. More changes in phytoplankton are expected when tertiary treatment of wastes entering the lake begins. (Buchanan-Davidson-Wisconsin) W76-13116

**LIGHT/DARK-PHASED CELL DIVISION IN EUGLA GRACILIS (Z) (EUGLENOPHYCEAE) IN PO4-LIMITED CONTINUOUS CULTURE**, New York State Univ at Albany. Dept. of Biological Sciences. S. W. Chisholm, R. G. Stross, and P. A. Nobbs. Journal of Phycology, Vol. 11, No. 4, p. 367-373, 1975. 7 fig., 35 ref. NSF GV 29347 and AG-199, 40-193-69.

Descriptors: \*Euglena, \*Limiting factors, Biorhythms, Phosphates, \*Cytological studies, \*Cultures, Growth rates, Laboratory tests, Phosphorus, Euglena, \*Euglenophyta. Identifiers: \*Euglena gracilis, Chemostats, Cyclostats.

Euglena gracilis cell density patterns and growth dynamics were studied in a light/dark entrained, phosphorus-limited chemostat (called cyclostats). Cell division was restricted to dark periods regardless of the number of cells dividing in each 24 hour period. Growth rate (amplitudes of cell density oscillation) was correlated with dilution rates. Division gate width, analyzed with a phasing index, was narrowest at dilution rates where the mean generation time of the cell population was an even multiple of 24 hours. This was due to enhanced phasing of the cell division process by the biological clock of Euglena. At all submaximal growth rates, residual phosphate levels in the cyclostats were below 0.3 micromoles phosphate. Cellular phosphorus concentrations increased with dilution rates as described by a hyperbola saturating at a maximum dilution rate of 0.74 per day with 8 x 10 to the 8th power micromoles phosphorus/cell as the minimum intracellular phosphorus concentration for growth. Similarities and differences between chemostats and cyclostats are discussed. Because the light/dark cycle is a strong natural selective force, cyclostats represent an improvement over the chemostat. A major difference is that dilution rate cannot be equated to growth rate, except when averaged over 24 hours thus gaining ecological relevance. (Buchanan-Davidson-Wisconsin) W76-13117

**DIATOM COMMUNITIES FROM A DELAWARE SALT MARSH**, Delaware Univ., Newark. Dept. of Biological Sciences. M. J. Sullivan. Journal of Phycology, Vol. 11, No. 4, p. 384-390, 1975. 5 tab., 13 ref.

Descriptors: \*Soil algae, \*Diatoms, \*Biological communities, \*Salt marshes, \*Delaware, Varieties, Ecological distribution, Habitats, Dominant organisms, Vegetation. Identifiers: \*Canary Creek (Del).

The taxonomic composition of edaphic diatom communities from five representative habitats of the Canary Creek salt marsh, Lewes, Delaware, was studied. Of 104 diatom taxa, 32 were distributed throughout the marsh and 41 were endemic to only one habitat. Three habitats sup-

ported grass stands (tall Spartina alterniflora, dwarf S. alterniflora, and Distichlis spicata) which covered 90% of the marsh surface. These habitats had the highest species diversity and greatest numbers of diatom species. The grassy cover prevented exposure to hypersaline conditions for prolonged periods and influenced temperature, which affected diatom reproduction rates. Bare bank and panne habitats were devoid of macroscopic vegetation and their diatom populations were exposed to hypersaline conditions in warmer seasons. Each habitat supported its own unique, edaphic diatom community. Community differences were related to temperature and elevation differences and interactions between edaphic diatoms and filamentous algae. Species diversity and species numbers were greatest for edaphic communities associated with dwarf S. alterniflora and D. spicata habitats, lowest for panne, and intermediate for bare bank and tall S. alterniflora habitats. Similarity index comparisons of community structure described the similarities or dissimilarities of two communities more adequately than comparisons of species diversity. The communities showed a high degree of dissimilarity. (Buchanan-Davidson-Wisconsin) W76-13118

**REGULATION OF NITRATE ASSIMILATION BY AMINO ACIDS IN CHLORELLA**, Karachi Univ. (Pakistan). Dept. of Botany. Z. Abdullah, and J. Ahmed. Plant and Cell Physiology, Vol. 16, No. 6, p. 971-974, 1975. 6 tab., 15 ref.

Descriptors: \*Plant physiology, \*Nitrogen fixation, \*Amino acids, \*Inhibition, Chlorella, Algae, Respiration, Metabolism, Enzymes, Denitrification, Ammonia, \*Absorption, \*Chlorophyta. Identifiers: \*Chlorella fusca.

Control of nitrate assimilation by exogenous amino acid supplies to the medium was studied in the green alga Chlorella fusca. Methionine, proline, valine, threonine, histidine, and glutamic acid inhibited nitrate assimilation. Alanine, tryptophan, arginine, lysine, leucine, and aspartic acid did not. Inhibition of nitrate assimilation was due to inhibition or repression of nitrate reductase. Complete destruction of reductase activity by methionine, proline, and valine indicated that nitrate reductase was both repressed and inactivated. Inhibition was reversed by non-repressors. Both amino acid classes interacted but no non-repressor amino acids behaved as universal derepressors. Leucine derepressed all repressors except glutamic acid; aspartic acid derepressed all repressors but not in the presence of threonine. Amino acids which inhibit nitrate assimilation may inhibit nitrate entry into cells. Methionine, proline, valine, histidine, and glutamic acid repressed nitrate reductase in Chlorella and cultured tobacco cells; alanine, asparagine, and leucine were non-repressors in Chlorella but repressors in tobacco. Non-repressors were not all derepressors; some repressor pairs were non-repressive, but pairs of methionine, proline, and valine were always repressive. (Buchanan-Davidson-Wisconsin) W76-13119

**FIELD DETERMINATION OF THE CRITICAL NUTRIENT CONCENTRATIONS FOR CLADOPHORA IN STREAMS**, Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section. S. L. Wong, and B. Clark. Journal of the Fisheries Research Board of Canada, Vol. 33, No. 1, p. 85-92, 1976. 4 fig., 1 tab., 19 ref.

Descriptors: \*On-site-tests, \*Nutrient requirements, \*Cladophora, \*Streams, \*Canada, Aquatic weeds, Phosphorus, Plant tissues, Productivity, Aquatic weed control. Identifiers: \*Phosphorus load, North Thames River (Ontario), Avon River (Ontario), Middle

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Maitland River(Ontario), Bayfield River(Ontario), Nith River(Ontario), Conestogo River(Ontario).

Because many streams in southern Ontario have excessive seasonal growths of aquatic plants such as *Cladophora* and *Potamogeton*, critical phosphorus and nitrogen concentrations for *Cladophora* were determined in six rivers. A direct relationship between ambient phosphorus concentrations in water and phosphorus concentrations in plant tissue with a regression coefficient of 0.87 was observed. Determination of actual phosphorus concentrations below which the specific *Cladophora* growth rate was reduced was hard to determine, especially under field conditions; it is approximately 1.6 mg phosphorus/g dry wt in tissue and 0.06 mg/l in water. No significant correlation was observed between the nitrogen content of plant tissue and that of water. Correlation of total phosphorus with plant growth can be used to estimate the waste load which would cause maximum growth of *Cladophora*. However this does not have any predictive value with respect to total biomass or dissolved oxygen fluctuations. Because plant tissue phosphorus content is less affected by daily fluctuations in ambient phosphorus concentration, it can be used to predict the average ambient nutrient concentration in a river reach over a period of time with fewer samples. (Buchanan-Davidson—Wisconsin) W76-13120

**DYNAMICS OF NUMBER AND BIOMASS OF PLANKTONIC INFUSORIA IN OPEN ZONES OF KREMENCHUG RESERVOIR AND THEIR PRODUCTION AND ROLE IN ORGANIC MATTER DESTRUCTION, (IN RUSSIAN),** Akademiya Nauk URSS, Kiev. Institut Hidrobiologii. For primary bibliographic entry see Field 2H. W76-13141

**AN ATTEMPT TO EVALUATE THE STATE OF HEALTH OF FISH FROM THE LYNIA AND WALSAZ RIVERS IN CONNECTION TO THEIR POLLUTION, (IN POLISH),** H. Dabrowska. Przegl Zool. 18(3), p 390-395, 1974.

Descriptors: Water pollution effects, \*Fish diseases, Europe, \*Fish parasites, \*Waste disposal, Outfall sewer, Outlets, Organoleptic properties, Perches, Pikes, Rivers, Trematodes. Identifiers: *Acanthocephalus*-Sp, *Chondrostoma*-Nasus, Chub, Gudgeon, Orfe, Perch, \*Poland, Roach, Rudd, Silver bream, Trichodina, Walsza River(Poland), Lynia River(Poland).

Parasitological, anatomo-histopathological and organoleptic studies of fish caught by an electric device above and below the outlet of wastes into the Lynia and Walsza Rivers (Poland) were carried out. From the Lynia River, pike, roach, perch, silver bream, orfe, rudd and chub were examined; *Chondrostoma nasus*, roach, chub and gudgeon were taken from the Walsza River. Parasites (21 spp.) were found; 14 on fish from the Lynia River and 8 on fish from the Walsza River. Most numerous were eye trematodes—91.6% (Lynia) and 56.6% (Walsza), the Trichodina 79.1% (Lynia), and *Acanthocephalus* sp. 54.1% (Lynia). Intensity of parasite infection was much higher in both rivers in fish caught at polluted stations. Histological examination of gills showed that 70% of fish from the Lynia had necrobiotic changes of the epithelium and disorders in the gill circulation system. In fish caught at the clean station, gills were generally in good condition.—Copyright 1975, Biological Abstracts, Inc. W76-13192

**CHARACTERISTICS OF THE PRIMARY PRODUCTION IN THE SALMON BREEDING LAKE, (IN RUSSIAN),** Akademiya Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod.

Y. I. Sorokin, E. B. Pavel'eva, and M. I. Vasil'eva. Zh Obshch Biol. 35(5), p 746-755, 1974.

Descriptors: \*Primary productivity, \*Lakes, \*Biomass, \*Algae, Eutrophication, Nutrients, Fertilization, Breeding, Water pollution effects, \*Salmon. Identifiers: *Oncorhynchus*-Nerka, Russian-SFSR, Lake Dalnee(USSR), Kamchatka.

During 2 seasons primary production was estimated in Lake Dalnee (Kamchatka) (Russian SFSR, USSR) the breeding place of *Oncorhynchus nerka*. Primary production in 1970 was 171; and in 1971, 147 gC/m<sup>2</sup>/yr. The average biomass of algae in water column was correspondingly 0.7 and 1.4 gC/m<sup>2</sup>. Primary production in the lake is still relatively high and is not seriously influenced by the decrease in nutrient income caused by the drop in the number of fish arriving for breeding, and so fertilizing it.—Copyright 1975, Biological Abstracts, Inc. W76-13193

**CONTENT OF SOME TRACE ELEMENTS IN MACROPHYTES OF THE VOLGA DELTA, (IN RUSSIAN),** Kaspiiskii Nauchno-Issledovatel'skii Institut Rybnogo Khozyaistva, Astrakhan (USSR). For primary bibliographic entry see Field 5A. W76-13194

**QUANTITATIVE DYNAMICS OF BACTERIA IN THE KREMENCHUG RESERVOIR, (IN RUSSIAN),** Akademiya Nauk URSS, Kiev. Institut Hidrobiologii. N. I. Sakharova, and L. G. Brantsevich. Gidrobiol Zh. 10(4), p 94-96, 1974.

Descriptors: \*Bacteria, Seasonal, Reservoir, Spatial distribution, Temporal distribution, \*Distribution patterns, \*Algae, Microorganisms, Benthos. Identifiers: \*Azotobacter-Like organisms, \*Bacilli, \*Cocci, Spores, Ukrainian-SSR, Dniepr River(USSR), \*Kremenchug Reservoir(USSR).

The vertical, horizontal and seasonal distribution of bacilli, cocci, spores, azoto-bacter-like and other organisms was studied in the water and bottom deposits of the Kremenchug Reservoir on the Dniepr River (Ukrainian SSR, USSR). A comparative evaluation of the distribution of algae and bacteria of different morphological groups showed that neither the abundance of algae nor their physiological state affected the relationship of the morphological groups of bacteria in the aquatic biocenoses. In all cases bacilli predominated over cocci, and among the bacilli, the nonsporulating predominated. However, there was a direct and inverse relation between the number of algae and content of microorganisms in the water and bottom deposits, which was determined not only by the abundance of algae but also by their physiological state.—Copyright 1975, Biological Abstracts, Inc. W76-13195

**ZOOPLANKTON POPULATIONS IN THE "WATER-SPORTBAAN GEORGES NACHEZ" AT GHENT IN 1972, A YEAR OF CONTINUOUS WATERBLOOMING, (IN FLEMISH),** Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen. J. De Maesseneer. Natuurwet Tijdschr. 55(4-6), p 193-201, 1973.

Descriptors: \*Zooplankton, \*Eutrophication, \*Sampling, Europe, Algae, Aquatic plants, Crustaceans, Daphnia. Identifiers: *Asplanchna*, \*Belgium(Ghent), Bosmina, *Brachionus*-Angularis, *Brachionus*-Calyciflorus, *Filinia*-Longiseta, *Keratella*-Cochlearis, *Keratella*-Quadrata, *Phormidium*-Sp,

*Polyarthra*, *Pompholyx*-Sulcata, *Stephanodiscus*-Sp.

Zooplankton populations in samples collected weekly in the 'Nationale Water-sportbaan Georges Nachez' at Ghent (Belgium) in 1972 were quite different from those in 1969. The latter year was characterized by the absence of waterblooming, during the former, extensive blooms of *Stephanodiscus* sp. (early Spring) and *Phormidium* sp. (rest of the year) developed. Cladoceran populations (*Bosmina* and especially *Daphnia*) were severely reduced in 1972. Nauplii also decreased in 1972. Cyclopids, however, did not seem to be adversely affected. With the exception of *Brachionus angularis* and *Polyarthra*, populations of *B. calyciflorus*, *Keratella cochlearis*, *K. quadrata*, *Filinia longiseta*, *Asplanchna* and *Pompholyx sulcata* were higher in 1972. The more regular presence of *Polyarthra*, *F. longiseta* and *B. angularis* in 1972 is also obvious as well as the earlier appearance of *P. sulcata*. It is not known whether the influence of the waterblooming is direct.—Copyright 1975, Biological Abstracts, Inc. W76-13196

**LONG-TERM CHANGES IN THE BENTHOS BIOMASS OF THE KUIBYSHEV WATER STORAGE BASIN, (IN RUSSIAN),** Akademiya Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod. S. M. Lyakhov. Gidrobiol Zh. 10(4), p 21-23, 1974.

Descriptors: \*Biomass, \*Benthos, Water storage, Trophic level, River basins, Sediments, Mud. Identifiers: \*Kuibyshev River basin(USSR).

For a long time, benthos on the flooded land of the Kuibyshev water storage basin (Russian SFSR, USSR) was extremely poor because of unfavorable trophic conditions. Recently (since 1966) accumulation of mud sediments and a rise in the trophic level have resulted in a 5-7-fold increase of the benthos biomass in this area with simultaneous growth in the former Volga bed. The next successional stage in the water storage basin benthos—the stage of biotope leveling—will be very long.—Copyright 1975, Biological Abstracts, Inc. W76-13198

**FEEDING OF THE BRONZE BREAM OF THE GORKI RESERVOIR IN THE DISCHARGE ZONE OF THE KOSTROMA STATE REGIONAL ELECTRIC POWER PLANT, (IN RUSSIAN),** T. S. Zhiteneva. Gidrobiol Zh. 10(4), p 104-107, 1974.

Descriptors: Fish, \*Water temperature, Metabolism, Electric powerplants, \*Fish food organisms, Growth rates, Reservoirs, \*Thermal pollution. Identifiers: \*Bronze bream, \*Gorki Reservoir(USSR).

The Kostroma state regional electric power plant, at the mouth of the Shacha River on the Gorki reservoir (Russian SFSR, USSR) was put into operation in 1969. At the water temperature characteristic for the discharge zone of the plant the metabolism of the bronze bream is elevated and the food requirement is high. However, both the quantity and quality of the food available to the bream are low, which has an adverse effect on growth of the fish. In the discharge zone of the power plant the poor feeding conditions are due to destruction of the bottom and shore biocenoses during construction.—Copyright 1975, Biological Abstracts, Inc. W76-13199

**PRODUCTION OF PONTOGAMMARUS ROBUSTOIDES GRIMM. IN THE RESERVOIR-COOLER OF THE KURAKHOVIAN STATE RE-**



**GIONAL ELECTRIC POWER STATION, (IN RUSSIAN),**  
Akademiya Nauk URSR, Kiev. Instytut Hidrobiologii.  
L. A. Kititsina, and M. L. Pidgaiko.  
Gidrobiol Zh. 10(4), p 30-37, 1974.

Descriptors: \*Crustaceans, Electric powerplants, \*Thermal pollution, Water temperature, Heated water, Biomass, \*Reproduction.  
Identifiers: \*Pontogammarus-Robustoides, Tubifex, USSR.

The production of 2 P. robustoides populations was estimated in the reservoir sections (USSR) characterized by different temperature conditions. Age structure of the population changes in the heated section 1-2 mo. earlier than in the control. Production of P. robustoides in the heated zone reaches its peak in spring; in the control, in summer. Under heated conditions the average annual biomass is reproduced 5 times in a year cycle and 4 times in the control. Cladophora and Tubifex are the principal foods.—Copyright 1975, Biological Abstracts, Inc.  
W76-13200

## 5D. Waste Treatment Processes

**LAND APPLICATION OF WASTEWATER, (LITERATURE REVIEW),**  
New York State Dept. of Environmental Conservation, Albany.  
T.J. Tofflemire.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1180-1191, June, 1976. 138 ref.

Descriptors: \*Water reuse, \*Irrigation, \*Overland flow, \*Infiltration, Groundwater recharge, Economics, Injection wells, Bacteria, Percolation, Lakes, Surface waters, Groundwater, Land use, Symbiosis, Phosphates, Nitrogen, \*Reviews, \*Bibliographies.  
Identifiers: \*Land application, \*Literature reviews.

A literature review of papers dealing with the application of waste water to land via irrigation, overland flow, and infiltration is presented. Specific topics covered include: the loading constraints of land treatment systems, cost curves for general types of land application systems, research on the spray irrigation of lagoon effluent on mixed pine hardwood forests, systems involving spray irrigation and recycling to lakes, the advantages of drip or trickle irrigation over flood or ridge and furrow methods, shallow injection well recharge with tertiary effluent, techniques for conducting sanitary surveys, phosphate removals in duckweed irrigated with various amounts of secondary effluent, waste water nitrogen removal by crop irrigation systems, bacterial aerosols associated with spray irrigation of chlorinated secondary effluent, percolation tests for rapid infiltration system design, and disposal well operating problems and solutions. (Kreager-FIRL)  
W76-12676

**WATER RECLAMATION AND REUSE, (LITERATURE REVIEW),**  
Municipal Environmental Research Lab., Cincinnati, Ohio. Wastewater Research Div.  
J.N. English, and T. M. Mitchell.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1180-1190, June, 1976. 57 ref.

Descriptors: \*Water reuse, \*Reclamation, \*Reclaimed water, \*Waste water treatment, \*Recycling, Irrigation, Groundwater recharge, Model studies, Industrial wastes, Municipal wastes, Ion exchange, Treatment facilities, Potable water, Economics, \*Reviews, \*Bibliographies.  
Identifiers: \*Literature reviews.

A review of literature dealing with water reclamation and reuse is presented. Topics covered include: surveys of municipal waste water reuse, a simulation model for evaluating the economic efficiency of water reuse, the use of water recycle in poultry processing plants, automatic car wash water recycle systems, the use of ion exchange for the removal of color and minerals from kraft bleach plant waste, municipal irrigation systems, injection systems for using tertiary treated trickling filter effluent for groundwater recharge, a computerized model of a treatment system capable of producing potable water from secondary effluent, and modifications to existing waste water treatment systems to allow for future reuse of effluent. (Kreager-FIRL)  
W76-12677

**AN ASSESSMENT OF THE AIRBORNE EMISSION OF SELECTED VIRUSES BY WASTE-WATER TREATMENT FACILITIES,**  
Michigan Univ., Ann Arbor.  
For primary bibliographic entry see Field 5A.  
W76-12678

**INTER-RELATION OF KEY-FACTORS FOR INFILTRATION OF LIQUID DOMESTIC WASTE INTO SOIL,**  
Connecticut Univ., Storrs.  
F. W. Kropf.

Available from University Microfilms, Inc., Ann Arbor, Mich., 48106, Order No. 76-10,274. Ph.D. Thesis, 1976, 84 p.

Descriptors: \*Waste water treatment, \*Infiltration, \*Infiltration rates, \*Waste disposal, \*Effluents, Domestic wastes, Liquid wastes, Absorption, Septic tanks.  
Identifiers: Land application, Septic tank effluents.

Soil disposal systems are frequently a valid alternative to aquatic disposal; their long term absorption capacity is controlled by either the hydraulic criterion or the infiltration criterion, which is the acceptance rate of the biological slime layer at the soil interface. Columns of three representative soils were flooded with septic tank effluent, either continuously, for 6 hours once a day, or for 12 half hour periods daily. Intermittent flooding was not advantageous for long term operation. The biological slime layer causing the clogging did not become completely impervious; the minimum infiltration rates were one to 2 cm/day. The effect of soil permeability on absorption rate was relatively small, provided the system was governed by the infiltration criterion. The infiltration interface orientation did not affect the infiltration rate. Continuous slime layer inundation did not adversely affect its capability to infiltrate liquid. Various design recommendations are outlined for fail-safe operation of small scale soil infiltration systems. (Snyder-FIRL)  
W76-12679

**SLUDGE PROCESSING, TRANSPORTATION AND DISPOSAL/RESOURCE RECOVERY: A PLANNING PERSPECTIVE,**  
Environmental Protection Agency, Washington, D.C. Div. of Water Planning.  
J. M. Wyatt, and P. E. White, Jr.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 013, \$7.75 in paper copy, \$3.00 in microfiche. Report EPA-440/9-76-002, December 1975, 201 p, 61 tab, 21 fig, 121 ref, append. EPA No. 68-01-3104.

Descriptors: \*Sewage treatment, \*Alternative planning, Sludge treatment, Sludge disposal, Sanitary engineering, Cost-benefit analysis, Water pollution, Transportation, Waste disposal, \*Waste treatment.

The purpose was to provide information to planning agencies regarding the sources, charac-

teristics, treatment methods, transportation modes, and ultimate disposal processes for residual wastes generated in municipal wastewater treatment plants. Technical, economic, social, and institutional factors pertinent to the alternatives are considered. Handling and treatment processes were evaluated in light of qualitative and quantitative changes to the residual wastes. Environmental, operational and institutional constraints to the use of ocean disposal, lagoons, sanitary landfills, sludge recycling, and land reclamation were presented. (Chilton-ORNL)  
W76-12683

**ATLANTIC RICHFIELD HANFORD COMPANY, QUARTERLY REPORT, TECHNOLOGY DEVELOPMENT FOR LONG-TERM MANAGEMENT OF HANFORD HIGH-LEVEL WASTE, JULY 1975 THROUGH SEPTEMBER 1975.**  
Atlantic Richfield Hanford Co., Richland, Wash. Advanced Waste Engineering Dept.  
Available from the National Technical Information Service, Springfield, VA 22161 as ARH-ST-132 A, \$4.50 in paper copy, \$3.00 in microfiche. Report ARH-ST-132 A, March 1976, 65 p, 9 tab, 8 fig, 5 ref. Kounts, J.S., Editor. E(45-1)-2130.

Descriptors: \*Waste disposal, \*Radioactive waste disposal, Engineering, Environmental engineering, Long-term planning.

A program for the development of technology for removal of waste from underground storage tanks, conversion of the waste to an improved stabilized form, and final storage of the immobilized waste in a location that does not require controlled management is reported on. A section on Storage System Integrity and Engineered Improvements establishes a data base and methodology for periodic evaluation of in-tank storage. The Immobilization and Storage section provides a summary of work associated with technology for the conversion of retrieved waste to an immobilized form satisfactory for final storage. Contaminated Equipment Volume Reduction section addresses the development and demonstration of methods for the reducing of radioactively contaminated metallic items to a size and form suitable for final storage or disposal. (Chilton-ORNL)  
W76-12684

**FEASIBILITY OF MICROBIAL DECOMPOSITION OF ORGANIC WASTES UNDER CONDITIONS IN DEEP WELLS,**  
Oklahoma State Univ., Stillwater. Dept. of Microbiology.

M. M. Grula, and E. A. Grula.  
Available from the National Technical Information Service, Springfield, VA 22161 as BERC/RI-76/6, \$4.50 in paper copy, \$3.00 in microfiche. Report BERC/RI-76/6, March 1976, 57 p, 18 tab, 22 ref. HO 122120, Modification No. III.

Descriptors: \*Waste treatment, \*Biodegradation, \*Microbial degradation, \*Deep wells, Organic wastes, \*Decomposing organic matter, Waste disposal.

The objective was to determine the feasibility of inoculation of the waste with bacteria which would decompose toxic substances underground through metabolic processes. Under aerobic conditions, temperature was not a constraint. Thermophilic bacteria decomposing a wide variety of compounds are readily obtained from ordinary soil. Mixed cultures were found to be more efficient biodegraders than pure cultures. High pressures inhibited biodegradation at high temperatures. All strains isolated grew well at 1000lb/sq. in. helium on a complex medium. Hyperbaric oxygen was toxic for all organisms tested. Attempts to derive modified strains with a higher growth temperature range than the parent strain failed. It was concluded that in situ biodegradation was not a reliable means of removing organic wastes in deep wells. (Chilton-ORNL)  
W76-12688

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

#### INTERIM SOLIDIFICATION OF SRP WASTE WITH SILICA, BENTONITE, OR PHOSPHORIC ACID,

Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.

G. H. Thompson.

Available from the National Technical Information Service, Springfield, VA 22161 as DP-1403, \$3.50 in paper copy, \$3.00 in microfiche. Report DP-1403, March 1976, 12 p, 1 fig, 2 tab, 12 ref. AT(07-2)-1.

Descriptors: \*Radioactive waste disposal, \*Alternative planning, Radioactive wastes, Storage, Chemistry, Separation techniques, South Carolina, Silica, Bentonite, Chemical reaction, \*Waste treatment.

Identifiers: Savannah River Plant(SC), \*Solidification(Nuclear wastes), Phosphoric acid.

Results of the study show that alkaline waste can be solidified by reaction with silica gel, silica flour, or sodium silicate solution. Alkaline supernate can be solidified by reaction with bentonite to form cancrinite powder. In both of these cases, the solidified wastes can be retrieved by slurring with water. Alkaline supernate can be solidified by partial evaporation and reaction with phosphoric acid. Plant waste treated in this way would not solidify completely because of decay heat. Reaction of simulated alkaline waste solutions with all of these resulted in increased volume. The best method for in-tank solidification appeared to be by evaporation since this contributes no additional solids and did not compromise any waste management options. (Chilton-ORNL)

W76-12690

#### CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING AS LOW AS PRACTICABLE GUIDES-FABRICATION OF LIGHT-WATER REACTOR FUELS CONTAINING PLUTONIUM, Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 5C.

W76-12694

#### ACTIVATED CARBON TREATMENT OF PHENOLIC PAINT STRIPPING WASTE-WATER,

Facet Enterprises Industries, Inc., Warwick, R.I. A. E. Perrotti.

Report AFCEC-TR-75-14, August 1975. 131 p, 63 fig, 15 tab, 7 ref, 2 append. F08638-74-C-0005.

Descriptors: Engineering, \*Water pollution, \*Waste water treatment, Civil engineering, Chemical engineering, On-site laboratories, Industrial wastes, Phenols, Water pollution sources, Paints, \*Activated carbon.

This study was conducted to ascertain the economical and technical practicality of using a granular carbon system for treating large volumes of phenol bearing wastewater from the depainting of aircraft and related equipment. Laboratory investigations characterized the waste water and evaluated different activated carbons for its treatment. A pilot plant was then set up at Kelly Air Force Base for treatment of phenol wastewater. In the pilot plant operation, carbon was exhausted five times and thermally regenerated four times. The pilot plant was operated intermittently for a period of six months. It was concluded that activated carbon was a viable treatment method for the removal of phenol and it was recommended that a full scale system be installed with a capacity of 50 gallons per minute flow. (Chilton-ORNL)

W76-12696

#### CHEMICAL WASTE LAND DISPOSAL FACILITY DEMONSTRATION GRANT APPLICATION, Barr Engineering Co., Minneapolis, Minn.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 747, \$7.50 in paper copy, \$3.00 in microfiche. EPA/530/SW-87d.i, 1976, 178 p. S 803744.

Descriptors: \*Waste disposal, \*Industrial wastes, \*Chemical wastes, Landfills, Liquid wastes, Solid wastes, Sludge disposal, Government finance, Grants, \*Minnesota.

This document is an application for a grant from EPA to Minnesota Pollution Control Agency to demonstrate land disposal techniques for potentially hazardous chemical wastes. It presents the demonstration approach to be used and identifies and discusses work tasks, potential facility designs, personnel needs, budget needs, contractor/consultant arrangements, implementation procedures, evaluating and reporting procedures, and the existing regulatory framework. (Chilton-ORNL)

W76-12699

#### OPERATIONS MANUAL ANAEROBIC SLUDGE DIGESTION,

Stevens, Thompson and Runyan, Inc., Portland, Ore.

C. Zickefoose, and R. B. J. Hayes.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-250 129, \$7.50 in paper copy, \$3.00 in microfiche. Report EPA 430/9-76-001, February 1976. 174 p, 34 fig, 16 tab. EPA No. 68-01-1706.

Descriptors: \*Waste disposal, \*Waste water treatment, \*Anaerobic digestion, Sludge disposal, Publications.

Identifiers: \*Operations manual(Treatment).

The manual covers the areas of troubleshooting, general operation, safety, start-up of units, basic theory, sampling and laboratory testing, and day-to-day operation of anaerobic digesters in municipal wastewater treatment plants. It is intended for use by plant operators and its format allows for easy use of portions of most interest. (Chilton-ORNL)

W76-12700

#### MEADOW/MARSH SYSTEMS AS SEWAGE TREATMENT PLANTS,

Brookhaven National Lab., Upton, N. Y.

M. M. Small.

Report BNL 20757, November 1975, 37 p, 6 fig, 2 tab, 22 ref.

Descriptors: \*Sewage treatment, \*Waste water treatment, \*Cost analysis, Ponds, Marshes, Grasslands, \*Treatment facilities, New York, Groundwater, Water reuse.

Identifiers: \*Long Island(NY).

The two sewage treatment systems reported upon are both closed, natural systems which produce no objectionable odors, no excess of flies or mosquitoes and release a minimum of airborne mists. Each system processes 10,000 gallons of domestic sewage per day and returns drinkable water to Long Island's ground water supply. Neither produces any sludge for further disposal. The two systems are called Meadow/Marsh/Pond (M/M/P) and the Marsh/Pond(M/P) systems. On the basis of investigations to date both systems can be recommended for use as sewage treatment plants, water producers and farms for sewage loads between 10,000 and 1,000,000 gallons per day. The M/P requires one half as much land and so has a lower first cost but it does not offer an upland crop for harvest and resale as does the M/M/P and for that reason may not be less expensive to operate. (Chilton-ORNL)

W76-12753

#### ACID DIGESTION OF COMBUSTIBLE WASTES: A STATUS REPORT,

Hanford Engineering Development Lab., Richland, Wash.

R. E. Lerch.

Report HEDL-TME 75-5, May 1975, 90 p, 15 fig, 29 tab, 27 ref.

Descriptors: \*Nuclear wastes, \*Waste treatment, Engineering feasibility, Chemical reactions, \*Degradation(Decomposition).

Identifiers: \*Acid digestion.

Tests using a 200 liter Acid Digestion Test Unit indicated the engineering feasibility of the process and showed acid digestion to be a potentially attractive method for treating combustible nuclear wastes. Hot concentrated sulfuric acid decomposed all common combustible waste materials when nitric acid was added as an oxidant. Decomposition produced an inorganic residue of sulfates and oxides having a volume of about 2-4% of the initial waste. Plutonium was largely converted to a nonrefractory form which is readily leached from the residue with nitric acid. Sulfuric acid is reusable. Nitrogen and sulfur oxides can be oxidized to provide a recyclable acid. (Chilton-ORNL)

W76-12776

#### THE IMPACT OF INCREASED FUEL COSTS AND INFLATION ON THE COST OF DESALTING SEA WATER AND BRACKISH WATERS, Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 3A.

W76-12778

#### TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: JULY - SEPTEMBER 1975,

Mound Lab., Miamisburg, Ohio.

C. J. Kershner, and J. C. Bixel.

Report MLM - 2288, March 1976, 30 p, 14 fig, 7 tab, 36 ref. E-33-1-GEN-53.

Descriptors: Reviews, \*Control systems, \*Tritium, Effluents, Liquid wastes, Spectrophotometry, \*Waste treatment, \*Pollutant identification, Separation techniques.

Basic separation and enrichment technology being developed and applied to gaseous and liquid effluent detritiation and recovery is reported. The major portion of the gaseous effluent treatment is presently in the pilot scale phase. Work on tritiated liquid waste decontamination (molecular excitation) continues. In preparation for experiments on the IR spectrum of HTO, a spectrophotometer cell has been modified for use with HTO and a cell loading system was assembled and tested. Work on electrolysis of high level tritiated water and catalytic exchange detritiation studies is reported. A tritiated water shipping container has been designed and developed for use with the ERDA-DOT approved Al-MI secondary container. (Chilton-ORNL)

W76-12779

#### TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: JANUARY - MARCH 1975,

Mound Lab., Miamisburg, Ohio.

C. J. Kershner, and J. C. Bixel.

Report MLM - 2235, August 1975, 28 p, 4 tab, 5 fig, 23 ref. E-33-1-GEN-53.

Descriptors: Reviews, \*Control systems, \*Tritium, Effluents, Wastes, Spectrophotometry, \*Waste treatment, \*Pollutant identification.

Progress on the tritium emission control project initiated at Mound Laboratory in 1972 is reported. Tritium is confined at the source through use of glove box atmosphere detritiation and in this regard a 100 cfm, pilot scale, helium purification unit was installed. HIP alloy-hydrogen isotherm data

# WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

## Waste Treatment Processes—Group 5D

were obtained at 28, 200, 400, and 600 degrees C. In catalytic exchange detritiation studies, approval drawings were received for a bench scale test system for evaluation of a hydrophobic catalyst for hydrogen/water exchange. In order to more clearly define the frequency and power of irradiation required for the molecular excitation, study of the HDO is spectrum was undertaken. This work will be expanded to HTO. In the tritiated liquid waste decontamination by molecular excitation program the isotope effects on the key reactions were calculated, the rate of the exchange reaction was analyzed, and the effect of the tritium beta decay on the water/hydrogen system was calculated in a qualitative manner. (Chilton-ORNL) W76-12780

**TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: OCTOBER - DECEMBER 1974.**  
Mound Lab., Miamisburg, Ohio.  
For primary bibliographic entry see Field 5G.  
W76-12781

**TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: APRIL - JUNE 1975.**  
Mound Lab., Miamisburg, Ohio.  
For primary bibliographic entry see Field 5G.  
W76-12782

**SUGAR PLANT WASTE WATER UTILIZED FOR IRRIGATION.**  
V. T. Dodolina, and V. M. Novikov.  
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A017 306, \$7.50 in paper copy, \$3.00 in microfiche. Draft Translation 500, November 1975, 9 p, 5 tab, 7 ref. Translated from Sakharnaya Promyshlennost, No. 1, 1975.

Descriptors: Agriculture, \*Waste water treatment, \*Irrigation, \*Sugar crops, Sewage disposal, Waste disposal, Water reuse.

It has been established that waste waters from sugar plants have a relatively high fertilization value when used in irrigation of agricultural crops. These waste waters make it possible to use less fruitful, marginal and other kinds of land for agricultural purposes. It was concluded that it would be expedient to alternate irrigations with filtered and unfiltered waste water and that, to this end, each sugar plant should create irrigation fields which will make it possible to rationally purify and utilize waste from sugar plants. (Chilton-ORNL) W76-12846

**TURBULENT BED COOLING TOWER.**  
Purdue Univ., Lafayette, Ind.  
R. G. Barile.  
Report EPA-660/2-75-027, June 1975, 32 p, 2 tab, 3 fig, 20 ref. 801867.

Descriptors: \*Engineering structures, \*Cooling towers, Cost analysis, Turbulence, Waste treatment, Treatment facilities.  
Identifiers: \*Turbulent bed cooling towers.

A primary concern in assessing the turbulent bed cooling tower was to compare it with acceptable towers already in use. The turbulent bed uses light, hollow plastic spheres as a packing which fluidize as air flows upward through the bed, while water is sprayed downward over the bed. It was found that the turbulent bed cooling tower performed marginally as compared with conventional mechanical draft cooling towers. The turbulent bed cooling tower required almost twice the auxiliary power per unit cooling load but the capital investment should be less because of its smaller size. (Chilton-ORNL) W76-12847

**FUNDAMENTAL STUDY ON THE POST TREATMENT OF RO PERMEATES FROM ARMY WASTEWATERS.**  
Illinois Univ. at Urbana-Champaign. Dept. of Environmental Engineering.  
E. S. K. Chian, and P. P. K. Kuo.  
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-021 476, \$6.00 in paper copy, \$3.00 in microfiche. Technical Report ULLU-ENG-75-2026, October, 1975. 131 p, 44 fig, 19 tab, 74 ref, 2 append.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Biological treatment, \*Analytical techniques, \*Tertiary treatment, Organic matter, Waste water (Pollution), Ozone, \*Reverse osmosis.

The removal of organic matter in MUST hospital waste water after the reverse osmosis (RO) process by treating with ozone, activated carbon, and ion-exchange resins was studied. Biological pretreatment of MUST waste water followed by ultrafiltration (UF), RO and ozone processes were also studied for the removal of gross organic matter. Pretreatment of RO permeates by activated carbon enhanced organic removal by ozonation while ion-exchange pre-treatment hindered its removal. Organic removal by both activated carbon and ion-exchange pre-treatment was enhanced when the RO permeates were pre-treated with ozone. The advantage of biological pre-treatment for reducing the power requirement for the later ozonation step was not obvious. The mechanism of organic removal by ozonation followed pseudo first order reaction kinetics during the early stage. Pseudo first order kinetics were also found in the second stage of ozonation, but at a greatly reduced rate. Stripping and distillation techniques and direct GC analysis were developed to analyze volatile organic compounds present in RO permeates. Solvent extraction coupled with high pressure liquid chromatography (HPLC) technique was developed to analyze nonvolatiles. Methanol and acetone were present in most of the RO permeates of MUST hospital wastes and o-toluidine and NN-diethyl-m-tolamide were present in the RO permeate of composite waste. (Snyder-FIRL) W76-12851

**AMMONIA REMOVAL FROM WASTE-WATERS: A REVIEW OF THE STATE OF THE ART.**  
Army Dugway Proving Ground, Utah.  
J. H. Whiting, and A. P. Adams.  
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A020 698, \$4.00 in paper copy, \$3.00 in microfiche. Technical Report 4904, Picatinny Arsenal, Dover, N. J., January, 1976. 57 p, 9 fig, 2 tab, 15 ref, 2 append.

Descriptors: \*Waste water treatment, \*Ion exchange, \*Reverse osmosis, \*Ammonia, \*Nitrification, \*Denitrification, Waste water (Pollution), Industrial wastes, Evaluation, Nitrates.  
Identifiers: \*Ammonia removal, Nitrification-denitrification, \*Air stripping, Breakpoint chlorination.

Processes to remove ammonia from munitions plant waste streams were reviewed and evaluated. Various explosive wastes and high levels of ammonia and nitrates are present in these waste waters. Abatement regulations require removal of both the ammonia and nitrates. Several processes, such as air stripping, ion exchange, and breakpoint chlorination, are effective in the removal of ammonia from waste waters, but they do not reduce the nitrate concentration. Other processes must be used to remove the nitrates, imposing additional costs. Biological nitrification-denitrification effectively reduces both ammonia and nitrate concentrations in the waste water. Ammonia is biologically oxidized to nitrite, then to nitrate which, in

turn, is reduced to nitrogen gas by the biological denitrification process. It is clean, efficient, and cost-effective. Reverse osmosis was also studied. (Snyder-FIRL) W76-12853

**A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE 'WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE'.**  
Systems Technology Corp., Dayton, Ohio.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-245 674, \$7.75 in paper copy, \$3.00 in microfiche. Report EPA-530-SW-109c, 1975. 217 p, 34 fig, 20 tab, 9 append.

Descriptors: \*Waste water treatment, \*Biochemical oxygen demand, \*Treatment facilities, \*Recycling, \*Solid wastes, Municipal wastes, Economics, Grants, Waste disposal, Evaluation.  
Identifiers: Municipal solid waste, Demonstration grants, \*Wet processing system.

Results are presented of a technical, economic, and environmental evaluation of the wet processing concept for the disposal of solid waste. The facility studied was the Franklin Solid Waste and Fiber Recovery, Plant, in Franklin, Ohio. The facility consists of three major systems; Hydrasposal (containing the pulping, separation, dewatering and incineration subsystems); fiber recovery; and glass recovery. When fiber recovery is not used, the facility requires additional water for pulping, but does not discharge water that would require treatment by a waste water treatment plant. With fiber recovery operational, the plant sends 2500 gallons of whitewater/ton of input refuse for treatment to the adjacent waste water treatment plant. Of the 3060 gallons of water/ton of input refuse required, 2300 gallons/ton comes from the final clarified water of the waste water treatment plant. Pulping and separation (P&S) involves dividing the solid waste into light and heavy streams. Waste water treatment sludge is introduced into the stream prior to the cone press dewatering step, the second of two steps in the dewatering process. The fiber recovery system receives the light fraction from the P&S subsystem and recovers a portion of the usable fiber contained in it. The impact on water quality as assessed by evaluating the influent and effluent flows. The output from the venturi scrubber does not require biological treatment, only solids removal. Eighty-one percent of the suspended solids loading and 73% of the biochemical oxygen demand (BOD) loading of the effluents leaving the plant are contributed by the effluent from fiber recovery. Economic data were developed for all major subsystems within the plant. (Snyder-FIRL) W76-12854

**REST AREA WASTEWATER TREATMENT AND DISPOSAL.**  
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
J. T. Pfeffer.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-246 061, \$4.50 in paper copy, \$3.00 in microfiche. Report ULLU-74-2030, November, 1974. 48 p, 4 fig, 12 tab, 15 ref. IHR-701.

Descriptors: \*Waste water treatment, \*Treatment facilities, \*Water reuse, \*Waste water disposal, \*Aerated lagoons, Physical control, Highways, Water quality, Flow.  
Identifiers: Highway rest areas, Series lagoons, Physical-chemical treatment.

Waste water treatment and disposal practices at interstate highway rest areas were studied. Rest area usage was analyzed to provide information regarding the quantity and quality of waste water as well as the variation in waste water flow. The in-



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

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formation obtained has been used to evaluate potential waste water treatment systems for rest areas. The major criteria used to evaluate the systems were process stability under widely fluctuating loadings, simplicity of operation, and aesthetic qualities. A series lagoon system most nearly satisfies these criteria. An aerated lagoon can be used as the first cell of the lagoon system when land or excavation costs are high, greatly reducing land area requirements. For rest areas having inadequate water supplies, the waste water can be reused for nonpotable uses. A physical-chemical system will produce effluent that will satisfy the quality requirements for nonpotable reuse. This type of system was analyzed for this purpose. Previous phases of the project are summarized. They include an analysis of existing data on the quality and quantity of waste water from interstate highway rest areas and an analysis of potential treatment systems for these waste streams. Laboratory data were obtained for the chemical treatment of the waste water from a rest area and are presented. (Snyder-FIRL)

W76-12855

**URBAN RUNOFF POLLUTION CONTROL PROGRAM OVERVIEW: FY'76**, Municipal Environmental Research Lab., Edison, N. J. Storm and Combined Sewer Section. For primary bibliographic entry see Field 5G. W76-12857

**URBAN STORMWATER RUNOFF: DETERMINATION OF VOLUMES AND FLOWRATES**, Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W76-12858

**RAW SEWAGE COAGULATION AND AEROBIC SLUDGE DIGESTION**, Environmental Science and Engineering, Inc., Gainesville, Fla. R. H. Jones, T. A. Burnszytnsky, and J. D. Crane. Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 107, \$6.00 in paper copy, \$3.00 in microfiche. Report EPA-600/2-75-049, November, 1975. 126 p, 31 fig, 16 tab, 20 ref, 4 append.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Biochemical oxygen demand, \*Chemical oxygen demand, Treatment facilities, \*Sludge digestion, Waste treatment, Waste water(Pollution), Sludge disposal, \*Aerobic treatment. Identifiers: Sludge drying.

Chemical coagulation of raw sewage was studied with laboratory tests and at a sewage treatment plant. A clarifier was converted to a chemical coagulation reactor and clarifier, and polyelectrolyte addition evaluated at various dosages and mixing speeds. Although various polyelectrolytes were efficient in the laboratory, they were less so in full-scale tests due to inadequate mixing. Significant biochemical oxygen demand (BOD) and suspended solids reductions occurred over a range of electrophoretic mobility values. Aerobic digestion of primary sewage sludge was also studied at varying detention times, loading rates, temperature, sludge qualities, seasonal flow, evaporation, and precipitation. Aerobic digester waste sludge may contain 40% less chemical oxygen demand (COD), 80% less BOD, 11% less total solids, and 26% less volatile solids than undigested primary sludge. Operating conditions were optimized based on behavior of digested sludge on sand beds. Properly digested sludge dried in 4 weeks with no objectionable odor. Phosphorus was under 0.4% by dry weight, Kjeldahl nitrogen under 3.7%, and nitrate plus nitrite nitrogen under 0.8 mg/gm of dry sludge. COD, BOD, total and volatile solids were reduced 30 to 50% during 70 days lagooning. Aerobically digested sludge seem amenable to mechani-

cal dewatering. Further gravity thickening was unsuccessful for digested primary sludge. Aerobic digestion stabilizes primary sewage sludge very well. Oxygen uptake rates up to 1.8 mg oxygen/(gm TS)(hr) occurred for digestion tests with sludge ages over 20 days. (Snyder-FIRL)

W76-12859

**STATE OF THE TECHNOLOGY SEMI-AUTOMATIC CONTROL OF ACTIVATED SLUDGE TREATMENT PLANTS**, Los Angeles County Sanitation Districts, Whittier, Calif. C. A. Nagel.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 067, \$7.75 in paper copy, \$3.00 in microfiche. Report EPA-600/2-75-058, December, 1975. 212 p, 59 fig, 14 tab, append.

Descriptors: \*Waste water treatment, Analytical techniques, \*Treatment facilities, \*Automatic control, \*Data processing, Waste treatment, Waste water(Pollution), Data storage and retrieval.

Devices that allow waste water treatment plant operators to monitor variable constituents, calculate important operating parameters, set and maintain proper process controls, and activate alarms are desirable, but present certain problems. The theory, design and operation of continuous on-line instrumentation currently in use by the County Sanitation Districts of Los Angeles County, California are documented, and computer applications which provide daily operational calculations are described. Aspects of instrumentation discussed include water level control of influent pumping, density control of primary sludge pumping, and process air, return sludge and waste sludge control in activated sludge plants. Theory, design, operation characteristics, and maintenance requirements are presented for each system. A computer application system provides daily operational parameters to the operators and prepares a monthly summary of operations reports. Other computer applications are reviewed, and a subroutine to compare effluent characteristics with discharge limits is included. These systems have proven to be reliable and practical. (Snyder-FIRL)

W76-12860

**ECONOMIC RESIDENTIAL PRESSURE SEWER SYSTEM WITH NO EFFLUENT**, SIECO, Inc., Columbus, Ind. G. F. Hendricks, and S. M. Rees. Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 195, \$5.00 in paper copy, \$3.00 in microfiche. Report EPA-600/2-75-072, December, 1975. 73 p, 18 fig, 10 tab, 4 ref.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Sewerage, \*Treatment facilities, \*Sewers, Sewage, Sewage disposal, Lagoons, \*Indiana. Identifiers: Pressure sewers, Effluent irrigation, Grandview Lake(Ind).

As the water level in Grandview Lake, Indiana, rose, it became polluted with effluent from septic tanks in the area. A conventional gravity sewer system and treatment plant would have been prohibitively expensive. A pressure sewer system with no polluting effluent was designed, constructed, and monitored for effectiveness. The elimination of groundwater infiltration and restrictive elevation tolerances associated with a conventional gravity sewer system enabled it to be installed and to function economically. Aerobic and anaerobic lagoon storage with subsequent irrigation of the effluent were used for treatment and yielded no more than normal volume of runoff. Inefficient home grinder-pump units resulted in operational problems with the pressure system. Commercially manufactured home units greatly

reduced these problems and increases in home construction resulted, then, the initial irrigation area proved inadequate and additional irrigation areas were made available. Domestic sewage nitrogen and phosphate were largely converted to vegetation at a reasonable cost. The treatment method produced no objectionable odors. Some additional operation and maintenance problems were caused by ground raw sewage due to the nature of the solids. Homeowners should be educated in the proper operation and maintenance of their home units. Any check valves in the home units should have a gate that, when closed, is at an oblique angle from the perpendicular alignment of the centerline of the flow in the pipe in order to use the gravitational advantage. Mechanical seals should be used when possible in infield fabrication operations to prevent leakage due to high ground-water conditions. (Snyder-FIRL)

W76-12861

**ULTRAVIOLET DISINFECTION OF ACTIVATED SLUDGE EFFLUENT DISCHARGING TO SHELLFISH WATERS**, Clow Corp., Florence, Ky. J. A. Roerber, and F. M. Hoot.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 460, \$5.00 in paper copy, \$3.00 in microfiche. Report EPA-600/2-75-060, December, 1975. 93 p, 12 fig, 13 tab, 7 ref, 6 append.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Activated sludge, \*Sewerage, \*Analytical techniques, Chemical oxygen demand, Treatment facilities, \*Disinfection, \*Ultraviolet radiation, Shellfish, Turbidity. Identifiers: Static tests.

A tertiary treatment plant and an ultraviolet disinfection chamber were installed following an activated sludge plant at a municipal sewage treatment plant. The effluent flows under ultraviolet lights through troughs. The amount of UV reaching the bottom of the trough is measured. If the UV is below a preset point known to give satisfactory disinfection, the effluent is automatically discharged to a holding lagoon instead of the receiving water. After the malfunction is corrected, the lagoon-stored effluent is pumped back through the plant for treatment. The determination of the coliform most probable number (MPN) was the primary evaluation test. MPN was not to be more than 70 per 100 ml. In static tests, an average ultraviolet dose of 25,000 microwatt sec per sq cm with an exposure time of 120 sec was required to produce an effluent with a coliform MPN Index less than 70. In flow-through tests, the coliform MPN was usually below 70 when the turbidity was below 11 JTU. The absorption of ultraviolet radiation was much more dependent on chemical oxygen demand (COD) than on turbidity. Exposure of samples to visible light after a sublethal dose of ultraviolet exposure favors the continued multiplication of bacteria. Bacteriophage inactivation followed first order kinetics. Coliform inactivation followed first order kinetics until 99.99% inactivation; followed by a tailing-off curve. Ultraviolet disinfection of effluents containing high solids and high organics was not possible. (Snyder-FIRL)

W76-12862

**TERTIARY TREATMENT FOR PHOSPHORUS REMOVAL AT ELY, MINNESOTA AWT PLANT, APRIL, 1973 THRU MARCH, 1974**, Municipal Environmental Research Lab., Cincinnati, Ohio. J. W. Sheehy, and F. L. Evans, III. Report EPA-600/2-76-082, March, 1976. 133 p, 16 fig, 12 tab, 3 ref, 6 append.

Descriptors: \*Waste water treatment, \*Treatment facilities, \*Sewage treatment, \*Sludge disposal, \*Phosphorus, Operating costs, Operation and maintenance, \*Minnesota, Lime, Filtration, Tertiary treatment, Waste water(Pollution), \*Design.

Identifiers: Chemical removal, \*Shagawa Lake(Minn), Clarification, Dual-media filtration.

The design, the construction and the first year's operation of the 1.5 mdg tertiary treatment plant located in Ely, Minnesota are discussed. The tertiary treatment plant was constructed to reduce the amount of phosphorus in the effluent from the existing filter plant, a point source that produces 80% of the phosphorus and about 1% of the surface flow entering culturally eutrophic Shagawa Lake. The tertiary plant was designed and constructed to reduce the total phosphorus concentration in the trickling filter plant effluent to 0.05 mg/liter, and consists of flow equalization, two-stage lime clarification followed by dual-media filtration and chlorination. The cost of treatment averaged \$0.24/cu m. Effluent total phosphorus concentration averaged 0.045 mg/liter. Performance data for the facility are included. The tertiary influent tank and the manually operated pump controller served to dampen hydraulic variations. The first-stage lime clarifier removed an average of 93.5% of the total influent phosphorus, while removal from two-stage clarification averaged 98%. The removal of soluble phosphorus, particulate phosphorus, and total phosphorus averaged 3%, 84% and 49%, respectively. Sludge handling problems encountered were high solids in the thickener overflow due to poor settling characteristics of the combined sludges and odors caused by processing undigested sludge. Conditioning sludge with lime increased the filter yield by 81%. Pertinent information on suspended solids, turbidity, TOC, calcium and iron removal is included. Waste water flow, chemical dose, pH, clarifier solids volume and gravity filter head loss are described. (Snyder-FIRL)

W76-12863

#### APOLLO COUNTY PARK WASTEWATER RECLAMATION PROJECT. ANTELOPE VALLEY, CALIFORNIA.

Los Angeles County Engineer Dept., Los Angeles, Calif.

H. T. Brandt, and R. E. Kuhns.

Report EPA-600/2-76-022, March, 1976. 341 p, 78 fig, 37 tab, 33 ref, 1 append.

Descriptors: \*Waste water treatment, \*Treatment facilities, \*Waste treatment, \*Nutrients, \*Algae, Aquatic plants, Recreation facilities, Fish, \*Water reuse, \*California.

Identifiers: Antelope Valley(Calif).

Results of a full scale demonstration project to confirm previous pilot studies and research on the economics and feasibility of reclaiming waste water for use at an aquatic park in a semi-arid area are reported. An oxidation pond tertiary waste water treatment facility involving flocculation with alum, sedimentation, filtration, and disinfection was constructed. The treatment system performance and the characteristics of the lake waters were evaluated as they relate to chemical, physical, and biological quality, algal growth, plant growth, fish pathology, soil reclamation, and irrigation. An effluent was produced that meets all water quality requirements. Alum sludge recycled through the primary treatment plant and sludge digesters had no adverse effect on the treatment processes. The water quality in the lakes has a sufficiently low nutrient level to avoid eutrophication. The water is also usable for irrigation, but because of the high sodium percentage and the increases in the boron and dissolved salts due to evaporation, precautions will be necessary to maintain soil quality. The completed recreational park attests to the economic benefits and social acceptability of waste water renovation. The tertiary treated water is pathogenically safe, esthetically pleasing, suitable for fish life and aquatic sports, and acceptable for irrigational use. (Snyder-FIRL)

W76-12864

#### REVIEW AND EVALUATION OF AVAILABLE TECHNIQUES FOR DETERMINING PERSISTENCE AND ROUTES OF DEGRADATION OF CHEMICAL SUBSTANCES IN THE ENVIRONMENT.

Syracuse Univ. Research Corp., N. Y. Life Sciences Div.

For primary bibliographic entry see Field 5A.

W76-12865

#### IMPROVED LIQUID-SOLIDS SEPARATION BY AN ALUMINUM COMPOUND IN ACTIVATED SLUDGE TREATMENT.

Greene County Board of Commissioners, Ohio.

C. F. Lenhart, and J. W. Cagle.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 228, \$4.50 in paper copy, \$3.00 in microfiche. Report EPA-600/2-75-039, September, 1975. 68 p, 34 fig, 3 tab, 9 ref.

Descriptors: \*Waste water treatment, \*Activated sludge, \*Biochemical oxygen demand, \*Treatment facilities, \*Phosphorus, Sludge digestion, Sewage treatment, Suspended solids, \*Separation techniques.

Identifiers: Settling.

The effects of sodium aluminate additions on activated sludge waste treatment were studied. Periods with and without chemical dosing were compared. Feeding sodium aluminate to a small to medium activated sludge waste water treatment plant is practical for gaining several operational benefits, including improved solids handling, easier sludge volume index control, and improved concentration of aerobically digested solids, particularly in cold weather. Sodium aluminate reduced suspended solids carryout of secondary clarifiers, reducing the loading to the microstrainers used for tertiary treatment, and increased sludge density, permitting protection against solids washout during spot flows greater than 164% of designed plant capacity. Phosphorus removal approached 80%; alkaline alumina feed cost \$.026 per 1000 gallons of waste water. Flow rates averaging 1.715 to 4.098 million gal per day, from 69 to 164% of design, were treated. Residual benefits accrued for 10 days after aluminate feed stopped; secondary clarifier conditions were not optimum until 3 days to a week after starting the aluminate. Solids settling in aeration basins and secondary clarifiers improved within 24 hr of startup. Thicker return sludge permitted a substantial reduction in waste activated sludge volumes. The secondary clarifier could retain higher MLSS. Return sludge volume rate was lower; less flow volume could deliver the same microorganism quantity. Chlorine demand was reduced; less solids and biochemical oxygen demand (BOD) entered the chlorine tank. BOD and SS loadings to the aeration tanks were reduced and increased concentrations of primary tank solids resulted when alumina was recycled. (Snyder-FIRL)

W76-12867

#### DESIGN AND TESTING OF A PROTOTYPE AUTOMATIC SEWER SAMPLING SYSTEM.

EG and G Washington Analytical Services Center, Inc., Rockville, Md.

For primary bibliographic entry see Field 5A.

W76-12872

#### TIOGA RIVER MINE DRAINAGE ABATEMENT PROJECT.

Pennsylvania Dept. of Environmental Resources, Harrisburg.

For primary bibliographic entry see Field 5G.

W76-12874

#### THE ENVIRONMENTAL IMPACT OF WATER CHLORINATION.

Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 5C.

W76-12876

#### CURRENT CHLORINATION AND DECHLORINATION PRACTICES IN THE TREATMENT OF POTABLE WATER, WASTE-WATER, AND COOLING WATER.

G. C. White.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 7-24. 11 ref.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Treatment facilities, \*Chlorination, \*Water treatment, \*Activated sludge, Disinfection, Hydrogen sulfide, Cooling water.

Identifiers: Dechlorination.

In sewage treatment, chlorine is used primarily for disinfection, but it is also effective for the prevention of septicity and the control of hydrogen sulfide generation. It is also used in limited applications such as control of activated sludge, bulking, sludge thickening, the destruction of cyanides, and foul air scrubbing. Chlorine is used in manufacturing ferric chloride, which is an effective coagulant for both potable water and waste water treatment. The amount of chlorine applied varies greatly, 50 to 400 lb per million gallon for waste water as compared to 5 to 100 lb per million gallon for potable water and 20 to 200 lb per million for cooling water. In the final analysis the required use of chlorine in potable water and waste water depends on local and Environmental Protection Agency regulatory requirements. It was stated that there is no alternative to chlorine as a disinfectant and chemical tool in the treatment of potable water, waste water, and cooling water. While there appear to be some disadvantages such as the formation of some undesirable chloro-organics, no other oxidant can combine all chlorine's positive attributes, such as its potency and wide range of effectiveness as a germicide, and its ease of handling, application, measurement, and control. (See also W76-12876) (Snyder-FIRL)

W76-12877

#### THE CHEMISTRY OF AQUEOUS CHLORINE IN RELATION TO WATER CHLORINATION.

Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

For primary bibliographic entry see Field 5C.

W76-12878

#### MEASUREMENT AND PERSISTENCE OF CHLORINE RESIDUALS IN NATURAL WATERS.

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

For primary bibliographic entry see Field 5A.

W76-12879

#### ORGANO-CHEMICAL IMPLICATIONS OF WATER CHLORINATION.

Minnesota Univ., Duluth. Dept. of Chemistry.

For primary bibliographic entry see Field 5C.

W76-12880

#### CHLORINATION OF ORGANICS IN COOLING WATERS AND PROCESS EFFLUENTS.

Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 5A.

W76-12882

#### ANALYSIS OF NEW CHLORINATED ORGANIC COMPOUNDS FORMED BY CHLORINATION OF MUNICIPAL WASTE-WATER.

North Texas State Univ., Denton. Inst. of Applied Sciences.

For primary bibliographic entry see Field 5A.

W76-12883

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

**CHLORINATED COMPOUNDS FOUND IN WASTE-TREATMENT EFFLUENTS AND THEIR CAPACITY TO BIOACCUMULATE**, Minnesota Univ., Duluth. Dept. of Chemistry. For primary bibliographic entry see Field 5A. W76-12891

**MICROBIOLOGY - DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES, (LITERATURE REVIEW)**, Environmental Research Center, Cincinnati, Ohio. For primary bibliographic entry see Field 5A. W76-12896

**LABORATORY EVALUATION OF POLYMER-IC FLOCCULANTS**, McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering. A. Benedek, and J. J. Bancsi. Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 17-28, February, 1976. 10 fig, 18 ref, 1 append.

Descriptors: \*Waste water treatment, \*Analytical techniques, \*Treatment facilities, \*Laboratory tests, \*Laboratory equipment, Flocculation, Polymers, Sampling, Settling velocity, \*Pollutant identification.

An adaptation of the method of multiple sampling during quiescent settling was used to study flocculation. A 35 cm high batch settling apparatus was used. It included a sampling tube 7.62 cm from the bottom surface and a stirring apparatus. Waste water with coagulant was mixed rapidly for 6 min, then slowly for 14 min. Any polymers used were added at 5 min. After the 20 min of mixing, the mixture was sampled automatically for 40 min as it settled. A Cahn Electro Balance was also used to determine the settling velocity distribution without sampling. An 8 ft high long tube settler was also used to simulate full-scale clarifiers where flocculation can take place during the entire downward passage of a floc. The modified jar test successfully yielded velocity size distributions. Settling in the batch settling apparatus is not affected by sampling errors. Phosphorus precipitate and other suspended solids enmesh in a chemical floc. Phosphorus and suspended solids concentrations are equally effective for monitoring settling. Comparison with results from the long tube settler indicates that the settling rates calculated from the batch settling apparatus test tend to be conservative due to lack of allowance for flocculation during settling. At least 5 min of rapid mix between coagulant and polymer addition, 1 min rapid mix after polymer addition, and 4 min of slow mix for flocculation are recommended for chemical flocculation studies in the batch settling apparatus. (Snyder-FIRL) W76-12898

**NASA TO TEST NEW TECHNIQUES FOR ON-STREAM WATER MONITORING**. For primary bibliographic entry see Field 5A. W76-12900

**INSTRUMENTATION AND AUTOMATION OF WASTEWATER COLLECTION AND TREATMENT SYSTEMS, (LITERATURE REVIEW)**, Municipal Environmental Research Lab., Cincinnati, Ohio. R. H. Wise, J. F. Roesler, and I. J. Kugelman. Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1206-1217, June, 1976. 138 ref.

Descriptors: \*Automation, \*Automatic control, \*Waste water treatment, \*Treatment facilities, \*Instrumentation, Sampling, Monitoring, Flow measurement, Computers, Equipment, Activated sludge, Data processing, Flow control, Reviews, \*Bibliographies. Identifiers: Collection systems, \*Literature reviews.

A review of literature dealing with the instrumentation and automation of waste water collection and treatment systems is presented. Topics covered include: guidelines for selecting on-line process analyzers, design improvements in on-line gas chromatographs, an automatic sampling and monitoring system for detecting accidental spills or other abnormally high discharges in industrial sewers, the evaluation of a commercial venturi that uses metal-membrane protected piezometers to detect fluid pressure changes, waste water treatment and water pollution abatement applications of a sonar-in-air liquid flow meter, the usefulness of existing optical methods for measuring turbidity, developments in control valves and flow control technology, the advantages of solid-state timing devices over electromechanical switches and timers, approaches to the real-time control of waste water variables, the design of fully automated waste treatment plants, the use of computer control in an automated activated sludge plant, and criteria for selecting a data acquisition system. (Kreager-FIRL) W76-12901

**HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS - EVALUATION OF KINETIC COEFFICIENTS**, Clemson Univ., S.C. Dept. of Environmental Systems Engineering. L. G. Rich, and S. C. White. Water and Sewage Works, Vol. 123, No. 6, p 90-92, June, 1976. 5 fig.

Descriptors: \*Oxidation lagoons, \*Aeration, \*Waste water treatment, \*Kinetics, \*Mathematical studies, Dissolved oxygen, Biochemical oxygen demand, Organic compounds, Suspended solids, Biological treatment, Equipment, \*Design criteria, \*Water quality standards.

Laboratory techniques and mathematical methods for estimating kinetic coefficients associated with the design of aerated lagoon systems are described. Retention time and power input are cited as the two main features of lagoon design. The selection of the former is based on a knowledge of which retention time provides the best solids removal with sedimentation for a particular waste and on the rate of soluble organic removal. The selection of power input is based on the amount of oxygen needed for respiration and biological conversion of the waste water and on the mixing requirements. Laboratory equipment and calculation procedures are illustrated for estimating changes in respiration rates and soluble biochemical oxygen demand, dissolved oxygen depletion rates, substrate removal rates, and respiration coefficients. (Kreager-FIRL) W76-12903

**ESTIMATING THE RELIABILITY OF ADVANCED WASTE TREATMENT**, Environmental Protection Agency, Cincinnati, Ohio. R. B. Dean, and S. L. Forsythe. Water and Sewage Works, Vol. 123, No. 6, p 87-89, June, 1976. 4 fig, 2 tab.

Descriptors: \*Statistical methods, \*Reliability, \*Tertiary treatment, \*Waste water treatment, \*Water quality, Phosphates, Mathematical studies, Evaluation, Performance, Treatment facilities, \*Estimating.

Statistical methods for estimating the reliability of advanced waste water treatment plants are discussed. Since the usual measurements of pollutants in waste water are lognormally distributed, plotting the data as a normal distribution is not appropriate and the plotting of cumulative probability distributions on log-probability paper becomes necessary. If a population can be fitted by a log-normal distribution, predictions about future per-

formance can be made with a high degree of confidence provided that the process is in statistical control (variations appear to result from consistent causes). Data on phosphate levels are taken from an advanced waste water treatment plant and are plotted normally and as their logarithms. The latter case produces a straight line, with a median value of 0.19 milligrams/liter and a spread factor of 2.1. The median is a good estimate of the geometric mean. (Kreager-FIRL) W76-12904

**COMPUTER HALTS FLOODING COMPLAINTS**, Watermaton, Inc., Saint Paul, Minn. D. J. Anderson, and R. O. Meyers. Water and Wastes Engineering, Vol. 13, No. 6, p 27-28, 30, 32, 62, June, 1976. 4 fig.

Descriptors: \*Sewers, \*Overflow, \*Mathematical models, \*Computer programs, \*Floods, \*Combined sewers, Analytical techniques, Costs, Economics.

The use of a computerized mathematical model to analyze flooding problems and raw sewage overflow has resulted in a cost savings amounting to two-thirds that of replacing the sewer system for the city of Lakewood, Ohio. The mathematical model used to analyze the city's sewer system involved three routines. One routine calculated the amount of rainfall which enters the sewers from the streets, rooftops, and grassed areas; and a second routine determined the amount of flow lost to the environment at various regulators in the system. A third routine computed the travel time for a given flow rate to traverse a pipe from the upstream to the downstream end. The alternative solution to sewer system replacement selected as a result of the computerized analysis involved the installation of 10 new control regulators to reduce combined sewer overflow at a cost of about \$24.3 million. (Kreager-FIRL) W76-12905

**VALUE ENGINEERING: MAKE SURE THE COSTS ARE RIGHT**, Minges (James S.) and Associates, Inc., Farmington, Conn. H. M. Wexler. Water and Wastes Engineering, Vol. 13, No. 6, p 34-36, 38, 49, June 1976. 5 fig.

Descriptors: \*Cost-benefit analysis, \*Costs, \*Benefits, \*Economics, \*Waste water treatment, \*Treatment facilities, Construction costs, Maintenance costs, Operating costs, Replacement costs. Identifiers: \*Value engineering.

Value engineering, a systematic approach to achieve cost savings without sacrifice of benefits, is discussed in relation to sewage treatment plants. The objective of value engineering for sewage treatment plants is to minimize life-cycle costs which consist of the initial construction costs of the facility as well as maintenance, operation, and replacement costs. It is imperative that a formal value engineering program be initiated as early as possible, especially before important design concept such as secondary treatment processes, tertiary filtration methods, types of lift stations, mode of building and process heating, and piping and materials are finalized. An example of the application of value engineering to the upgrading of a waste water treatment serving a population of about 20,000 is presented and reveals that in this particular case the abandonment of existing trickling filters in favor of rotating biological contactors results in up to a 50% savings in electrical energy consumption and more consistent performance. (Kreager-FIRL) W76-12906



**POPULATION BALANCE USE IN DILUTE IMPURITY PROBLEMS.**  
Iowa State Univ., Ames. Dept. of Nuclear Engineering; and Iowa State Univ., Ames. Dept. of Chemical Engineering.  
For primary bibliographic entry see Field 5B.  
W76-12914

**EVALUATION OF THE REPORT ON INTERCEPTOR SEWERS AND SUBURBAN SPRAWL.**  
Environmental Protection Agency, Washington, D.C. Office of Planning and Evaluation.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-250 617, \$4.00 in paper copy, \$3.00 in microfiche. January, 1975. 43 p, 4 tab, 6 append.

Descriptors: \*Waste water treatment, Analytical techniques, \*Sewerage, \*Flow rates, \*Interceptor sewers, Projects, Land use, Land development, Design, Human population, \*Sewers, Evaluation.  
Identifiers: Excess capacity.

An Environmental Protection Agency (EPA) study group evaluated the conclusions of the Urban Systems Research and Engineering, Incorporated (USRE) report for the Council on Environmental Quality, INTERCEPTOR SEWERS AND SUBURBAN SPRAWL. The report, based on an analysis of 52 interceptor projects and case studies from the larger sample, concluded that the presence of Federally financed interceptor sewers encourages development, and their routing, sizing, and timing influence land use patterns. It also concludes that current procedures and standards for design, review, and financing of projects strongly encourage unnecessarily large interceptor projects and do not stimulate public participation or ensure careful assessment of potential adverse secondary impacts and recommends that EPA not provide Federal funds for excess capacity, re-evaluate interceptor staging of projects in rapidly growing areas, use realistic standards for estimating per capita flow, improve population forecasting techniques and review procedures, require coordination of environmental effects of interceptor induced land use, and increase public participation by publicizing community cost and benefits of interceptor induced growth. The EPA group's 74 project survey agreed that half the land served by interceptor projects is vacant, but much of this sewerage was unavoidable. The EPA disagrees with limiting interceptor design life to 25 yr, because some projects are likely to be more cost effective with longer periods. EPA agrees that no arbitrary gpcd standards should be set; factors like combined sewers and high infiltration/inflow justified several seemingly excessive design flows. The EPA group agrees that population forecasting should be improved but finds the recommendation to limit financial aid to the portion of interceptors needed for current population inappropriate. (Snyder-FIRL)  
W76-12915

**AWT ENERGY NEEDS - A PRIME CONCERN.**  
Orange County Water District, Fountain Valley, Calif. Board of Directors.  
D. G. Argo, and C. M. Wesner.  
Water and Wastes Engineering, Vol. 13, No. 6, p 46-48, June, 1976. 2 tab.

Descriptors: \*Reclamation, \*Waste water treatment, \*Energy budget, \*Tertiary treatment, \*Treatment facilities, \*Electric power demand, \*Reclaimed water, Water reuse, Energy.

Off-site energy requirements associated with the operation of an advanced waste water treatment plant in Orange County, California are reviewed. Secondary effluent not reclaimed by the plant is discharged into the Pacific Ocean by pumping through an outfall and requires about 3000 kilowatt-hours/day for 15 mgd of effluent. The total maximum energy required to reclaim 15 million gallons/day of waste water is 95,000 kilowatt-

hours without demineralization and 130,000 kilowatt-hours/day with demineralization by reverse osmosis. These energy requirements include all treatment units and auxiliaries, such as plant water and lighting; also included are all energy requirements to manufacture and deliver consumable supplies used in the waste water reclamation process. A detailed breakdown of energy requirements is given by unit operation. (Kreager-FIRL)  
W76-12919

**STIMULATION OF DENITRIFICATION IN SOIL COLUMNS BY ADDING ORGANIC CARBON TO WASTEWATER.**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
J. C. Lance, and F. D. Whisler.  
Journal Water Pollution Control Federation, Vol. 48, No. 2, p 346-356, February, 1976. 7 fig, 2 tab, 19 ref.

Descriptors: \*Denitrification, \*Carbon, \*Waste water treatment, \*Soil filters, \*Recycling, \*Symbiosis, Nitrification, Nitrogen, Efficiencies, Filtration, Chemical reactions, Organic compounds, Evaluation, Simulation analysis.  
Identifiers: Dextrose.

Soil columns were intermittently flooded with waste water adjusted to different soluble carbon concentrations by adding dextrose or methanol to investigate the effect of organic carbon on denitrification. Methanol was not effective in promoting denitrification in soil columns flooded with secondary waste water; however nitrogen removal was increased from 30-90% by increasing the soluble carbon concentration of the waste water to 150 mg/liter via the addition of dextrose. This showed that the organic carbon content of waste water is capable of limiting denitrification in high-rate land filtration systems and that both nitrification and denitrification may be achieved in the same soil profile by alternating flooding and drying periods. Further research is needed to determine if most of the carbon would be removed from primary waste water effluent by high-rate land filtration and to determine if denitrification can be stimulated by adding carbon in a pulse at the beginning of the flooding period. (Kreager-FIRL)  
W76-12920

**AIRBORNE COLIPHAGES FROM WASTE-WATER TREATMENT FACILITIES.**  
Michigan Univ., Ann Arbor. School of Public Health.  
For primary bibliographic entry see Field 5A.  
W76-12921

**MOGDEN, WHERE SEWAGE WORKS.**  
C. W. Ireland.  
Gas and Oil Power, Vol. 71, No. 787, p 161-162, Winter, 1975. 2 fig, 1 tab.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Sludge digestion, \*Treatment facilities, \*Gases, \*Fuels, Equipment.  
Identifiers: Thames Water Authority, Mogden water works.

Fuel gas for engines is produced from the treatment of sewage at the Thames Water Authority's Mogden works. Heat recovered from the engine cooling systems raises the sludge digestion temperature to about 32°C. The engines drive generators for electric pumps and other equipment and air compressors delivering about 4.8 million cu m/day to the activated sludge process. The engine commissioned in 1967 was developed taking into account the difficulties of burning the very heavily contaminated sludge gas, and incorporated numerous special features. The fuel gas carries large quantities of condensate due to the close proximity of the digester to the power house. Operating

experience made it possible to develop the most efficient combination of engine components, which included many standard components. This experience allowed the engine installed in 1974 to be designed with components interchangeable with those of the 1967 engine. The 1974 engine also incorporated various improvements. The gas and air are mixed in the combustion chamber to avoid any possibility of an explosive mixture being formed in the manifold. The 1974 engine ran almost continuously for its first 12 months. Both engines are dual fuel engines; a pilot injection of diesel fuel oil promotes ignition of the gas and air. (Snyder-FIRL)  
W76-12923

**DISINFECTION, (LITERATURE REVIEW).**  
Georgia Inst. of Tech. Atlanta. School of Civil Engineering.  
For primary bibliographic entry see Field 5F.  
W76-12924

**DETERGENTS, (LITERATURE REVIEW).**  
Missouri Univ., Columbia.  
For primary bibliographic entry see Field 5C.  
W76-12925

**FREEZE TREATMENT OF ALUM SLUDGE.**  
Envirotech Corp., Salt Lake City, Utah. EIMCO BSP Div.  
For primary bibliographic entry see Field 5E.  
W76-12928

**SANITARY LANDFILL LEACHATES AND THEIR TREATMENT.**  
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
E. S. K. Chian, and F. B. DeWalle.  
Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 411-431, April, 1976. 5 fig, 6 tab, 52 ref, 1 append.

Descriptors: \*Waste water treatment, \*Pollutant identification, \*Biological treatment, \*Analytical techniques, Biochemical oxygen demand, Chemical oxygen demand, \*Landfills, \*Leachate.  
Identifiers: Physico-chemical treatment.

Leachate samples were collected from landfills in different parts of the United States and analyzed for both organics and inorganics. Ratios such as COD/TOC, BOD/COD, VS/FS, and total carbon present in the free volatile fatty acids/TOC were determined for the leachate. These ratios can be used to predict the effectiveness of either biological or physico-chemical treatment methods with a given leachate. Some are also used as an internal check on the reliability of the results of chemical analysis of leachate samples. Leachate from recently leaching landfills is best treated by biological treatment, which is most effective in removing the free volatile fatty acids which are present in large quantities. Physical-chemical treatment is most effective for treating leachate from stabilized landfills or further removing organic matter in the effluent of biological units treating leachate. Activated carbon and reverse osmosis were best among the physico-chemical processes evaluated for removing organic matter. (Snyder-FIRL)  
W76-12930

**CALCIUM HYDROXIDE (LIME) AND THE ELIMINATION OF HUMAN PATHOGENIC VIRUSES FROM SEWAGE: STUDIES WITH EXPERIMENTALLY CONTAMINATED (POLIOVIRUS TYPE 1, SABIN) AND PILOT PLANT SAMPLES.**  
Ottawa Univ. (Ontario). Faculty of Medicine.  
S. A. Sattar, S. Ramia, and J. C. N. Westwood.  
Canadian Journal of Public Health, Vol. 67, No. 3, p 221-226, May-June, 1976. 4 tab, 12 ref.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

**Descriptors:** \*Waste water treatment, \*Sewage treatment, \*Sewerage, \*Pollutant identification, \*Lime, \*Viruses, Sewage sludge, Waste storage, Temperature, Public health, Pilot plants, \*Calcium hydroxide, Chemical precipitation.  
**Identifiers:** Chemical treatment.

Use of lime was studied as a means to eliminate viruses from sewage. Sewage samples were contaminated with poliovirus 1. An aqueous slurry of lime was then added drop by drop until the pH reached 11.5. After 15 more min of stirring, the sample was allowed to stand for one hr. No virus was detected in the resulting supernatant; the virus recovered from the sludge represented only 0.001% of the virus added. This remaining virus was undetectable after storing the sludge for 24 hr at 28C. Lowering the temperature of the samples to 4C did not affect the process efficiency in eliminating viruses. (Snyder-FIRL)  
W76-12931

**ODOR CONTROL WITH HYDROGEN PEROXIDE,**  
Pennsylvania State Univ., Middletown. Dept. of Engineering.  
C. A. Cole, P. E. Paul, and H. P. Brewer.  
Journal Water Pollution Control Federation, Vol. 48, No. 2, p 297-306, February, 1976. 5 fig, 3 tab, 5 ref.

**Descriptors:** \*Waste water treatment, Pollutant identification, \*Treatment facilities, Odor, Control, Domestic wastes, Industrial wastes, Effluents, Hydrogen sulfide.  
**Identifiers:** \*Odor control, \*Hydrogen peroxide, Clarifiers.

Hydrogen peroxide treatment was investigated as a method of controlling the odors emanating from the Hershey waste water plant, which treats approximately 2 mgd of domestic and industrial waste. The plant odors came predominantly from the flotator-clarifier effluent that was aerated in the preaeration tank and exposed to air in the plastic media trickling filter and from the intermediate clarifier effluent that was exposed to air in the intermediate rock trickling filter. Hydrogen sulfide produced under anaerobic conditions in the flotator-clarifier and intermediate clarifier apparently produced the odor. Two winter tests followed by continuous use starting in the early summer demonstrated the effectiveness of hydrogen sulfide for controlling the odor. A dose of between 15 and 40 mg/liter hydrogen peroxide divided between the effluent from the plastic media trickling filter and the feed to the flotator-clarifier was effective. On-site observations and off-site tests by an odor panel verified the odor reduction. Adding 10 mg/liter hydrogen peroxide to the feed of the flotator-clarifier and intermediate clarifier during the afternoon high flow time increased the dissolved oxygen (DO) in the effluent of each by one to 2 mg/liter. Adding 10 mg/liter hydrogen peroxide did not improve the early morning low flow DO. (Snyder-FIRL)  
W76-12932

**THE ECONOMICS OF RECOVERY OF MATERIALS FROM INDUSTRIAL WASTE—A CASE STUDY,**  
Aston Univ., Birmingham (England). Dept. of Chemical Engineering.  
A. V. Bridgwater.  
Resource Recovery and Conservation, Vol. 1, No. 2, p 115-127, 1975.

**Descriptors:** \*Byproducts, \*Industrial wastes, \*Financial feasibility, \*Recycling, \*Return(Monetary), Chemical wastes, Europe, Water pollution control, Liquid wastes, Economics of scale, Waste treatment, Organic compounds, Metals.  
**Identifiers:** West Midlands(England).

The viability of recovering materials from liquid and liquid-solid industrial wastes is evaluated. A waste disposal contractor in the West Midlands, usually poured acid effluents into old coal mine shafts and phenolic wastes and metal-bearing sludges onto a brickpit surface. Effluents were analyzed for suitability before discharge, except that aqueous cyanide solutions were first oxidized with chlorine. Monitoring of liquids and atmosphere in the mine shaft indicated some acid neutralization and metal adsorption by the rocks occurred. Analyses of effluents and prices of materials contained in or derivable from effluents showed that hydrochloric acid, zinc, and non-ferrous metals were present in relatively large quantities, were the most valuable, and are relatively easy to recover. Preliminary studies for recovery of commercial hydrochloric acid indicated that for acid alone a return of more than 50% might be expected with a payback time of less than two years. For zinc oxide recovery the return was estimated at around 25% with a payback time of about three and a half years. An integrated approach to effluent treatment and material recovery rather than disposal would be more economical, reduce losses of valuable materials, preserve safe disposal sites for intractable wastes, and provide fast, efficient recycling of valuable materials. The attractiveness of recycling nickel and white spirits are illustrated. (Buchanan-Davidson-Wisconsin)  
W76-12948

**SOLID WASTE: IS THERE A PROFIT POTENTIAL,**  
Waste Management, Inc., Oak Brook, Ill.  
T. Bakkom.  
Pollution Engineering, Vol. 7, No. 11, p. 38-39, 1975.

**Descriptors:** \*Recycling, \*Industrial wastes, \*Waste disposal, \*By products, Methodology, Performance, Economic efficiency, Marketing.

The recovery of marketable materials from industrial wastes is contingent on efficient collection, storage, and transportation systems designed for the special production needs, volumes, and hazards of the wastes. Plant production should be studied to identify recoverable materials and determine feasibility of recovering waste fractions for recycling or sale. Recoverable material must be maintained at its maximum value. Containerization, storage, handling, and transportation systems for recoverable and unrecoverable materials from the point of waste generation to their final disposition must be planned. A case study of an international manufacturer and marketer of heavy equipment is presented. Because of environmental problems caused by incineration, alternative methods of waste handling and disposal were chosen. The improved system solved the environmental problem, used less manpower, reduced costs, used a private contractor's ability to recover secondary fibers for resale, handled waste without changing operating procedures or interrupting production, and met all solid waste demands with permitted disposal sites. The system is not currently considered as a 'profit center' but it does reduce the cost of waste handling and disposal—subject to the marketability of the recovered materials—and meets the primary criteria of efficiently removing wastes from production areas. (Buchanan-Davidson-Wisconsin)  
W76-12951

**PRELIMINARY ASSESSMENT OF SYSTEMS FOR DERIVING LIQUID AND GASEOUS FUELS FROM WASTE OR GROWN ORGANICS,**  
National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.  
R. W. Graham, T. W. Reynolds, and Y. Y. Hsu.  
Report No. NASA TN D-8165, February 1976. 41 p. 10 fig., 6 tab., 33 ref.

**Descriptors:** \*Fuels, \*Recycling, \*Feasibility studies, \*Energy conversion, Organic wastes, \*Anaerobic digestion, Environmental effects, Pilot plants, Vegetation, Farm wastes, Agriculture, Forests, Economic feasibility, Methane, Technology, Costs, Waste treatment.  
**Identifiers:** \*Pyrolysis system.

The overall feasibility of anaerobic digestion and pyrolysis systems to convert fuels from waste or grown organics is considered as related to the technical, economic and environmental aspects. Converting collectable organic waste into fuels appears attractive with the added advantage of waste disposal. The most conservative estimates indicate that 136 million tons/yr is 'readily collectable,' representing 1.4 in the 15th power Btu/yr; total U.S. energy consumption in 1971 was 72 in the 15th power Btu/yr. However conversion to liquid or gaseous fuels would reduce the energy content by the conversion efficiency. In the grown organic option, silviculture as a source of biomass for fuel conversion is evaluated and found that at a 50% conversion efficiency the costs of fuel would exceed the current cost of petroleum. Fuel crop production is not a viable alternative but biomass waste from food crops can be considered as a realistic fuel resource. The two conversion processes—fermentation and pyrolysis—are compared with regard to capital investment, environmental impacts, and their versatility. The energy from a system that uses waste and grown organic feedstocks is estimated at 4% to 12% of the 1971 U.S. energy consumption. Estimates of market prices for these fuels are included. (Auen-Wisconsin)  
W76-12967

**SOLAR ENERGY FIXATION AND CONVERSION WITH ALGAL BACTERIAL SYSTEMS,**  
California Univ., Berkeley. Sanitary Engineering Research Lab.  
M. Uziel, W. J. Oswald, and C. G. Golueke.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-242 362, \$3.50 in paper copy, \$3.00 in microfiche. Progress Report No. NSF-RA-N 74-195, December 1974. 13 p. 1 fig., 4 tab. NSF-RANN-SE GI-39216.

**Descriptors:** \*Electric power production, \*Methane, \*Energy conversion, \*Solar radiation, Anaerobic digestion, Waste treatment, Recycling, Scenedesmus, Euglena, Laboratory tests, Nitrogen, Harvesting of algae, Fermentation, Cyanophyta, Chlorophyta, \*Economic feasibility. **Identifiers:** Spirulina, Melosira, Oscillatoria, Microactinium, \*Solar energy fixation, \*Solar energy conversion.

The results of continuing laboratory tests conducted to determine the economic feasibility of a process based on the utilization of algal-bacterial cultures in sewage to fix solar energy into algal cellular material, which in turn is converted to methane by anaerobic digestion; the methane to be used through combustion for the generation of electricity. Implicit in the recycling aspects are the utilization of wastes and a source of nitrogenous fertilizer. This phase of the investigation produced data for the kinetic modeling of algae and methane production (anaerobic digestion) processes, and energy transformations; and the assessment of the comparative fermentability of *Melosira*, *Scenedesmus*, *Euglena*, *Microactinium*, *Spirulina* and *Oscillatoria*. The overall results indicate that with the exception of *Melosira*, all the species tested could serve equally well as a fermentation substrate for gas production. The methane concentration of the gas produced ranged from 69% to 71% of the total gas. The stability and reliability of the system was well demonstrated. Gas composition is not affected by type of algae fermented. Nitrogen is supplied by the sewage and/or atmospheric fixation by the blue-green algae. Any nitrogen introduced into the system can be kept within the system by recycling digester effluent to the algae ponds. (Auen-Wisconsin)  
W76-12968

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

**PHOSPHORUS REDUCTION WITH BIVALENT IRON SULFATE AT THE KAPPALA WATER PURIFICATION PLANT. (IN SWEDISH)**  
Kappalaverket, Lidingsö (Sweden).  
K. I. Dahlqvist, L. Hall, and L. Bergman.  
Vatten. 31(2), p 166-179, 1975.

Descriptors: \*Water purification, \*Water treatment, \*Sewage treatment, \*Phosphorus, Activated sludge, \*Waste water treatment.  
Identifiers: Kappala plant, \*Sweden(Kappala plant), \*Ferrous sulfate.

Ferrous sulfate is useful for phosphorus reduction in sewage plants. The quantities needed for water purification at the Kappala plant (Sweden), the effect on suspended matter, the relation to oxygenation, surplus slime, loss of phosphorus in water treatment tanks, the changes in gas production and composition and the effect on activated sludge were studied. Phosphorus reduction of 90% was achieved with 16-18 g iron/m<sup>3</sup>. Activated sludge was unaffected; gas production remained unchanged. Ferric hydroxide tended to clog aeration tubes, but this was easy to prevent.—Copyright 1976, Biological Abstracts, Inc.  
W76-12989

**SEWAGE EFFLUENT TURNED TO SNOW: PROVIDES STORAGE, REMOVES POLLUTANTS.**  
Wright-McLaughlin Engineers, Denver, Colo.  
K. R. Wright.  
Civil Engineering - ASCE, Vol. 46, No. 5, May 1976, 88-89, 1 tab.

Descriptors: \*Waste water disposal, \*Waste water treatment, \*Solid waste, \*Snow, \*Effluents, Biochemical oxygen demand, Hydrogen ion concentration, Suspended solids, Phosphate, Nitrates, Nitrogen, \*Colorado, Water quality.  
Identifiers: \*Clean Water Bill, \*Total dissolved solids, \*Winter storage, Yama River(CO), Routh County(CO), Land treatment, Nitrate-nitrogen.

To meet the goals of the Clean Water Bill (PL 92-500) for 1983 and 1985, and maintain classification of the Yama River (CO) as a cold water fishery, the Upper Yama Water Conservation District investigated the possibility of land application of treated sewage effluent as an alternative to reservoir storage. Small mountain area municipalities, ski resorts and mountain top restaurants would find converting effluent to snow useful for practical winter storage and to decrease pollutants in the process. The experiment was carried out in February through April 1974 at a ski area in Colorado. The Mt. Werner Sewage Treatment aerated lagoon liquid effluent was converted to snow by means of conventional snow making guns. Tests were made on the snow-melt using as sampling criteria: 5-day biological oxygen demand (BOD), total dissolved solids (TDS), total suspended solids, nitrate-nitrogen, total phosphate, and pH. The snow was slightly off-white in color with no noticeable odor. Comparisons between snow pack and wastewater resulted in the following conclusions: fecal coliform bacteria in snow pack was less than 200 per 100 ml, within limits of an A class stream; after 1 to 2.5 months in snow pack TDS concentrations decreased by an average of 85%; after 1 to 2.5 months there was 91% BOD removal within the snow pack; over a period of 2 months pH decreased from 7.9 to 7.0. (Gentry-North Carolina)  
W76-13048

**PRESENT-DAY AND FUTURE PROBLEMS CONCERNING THE PURIFICATION OF WATER USED IN RAISING PIGS, (IN FRENCH)**  
Institutul de Studii, Cercetari si Proiectari Pentru Gospodaria, Bucharest (Romania).  
V. Chiriac, I. Gueron, and C. Negulescu.  
Bull Acad Sci Agric For. 3, p 79-89, 1973.

Descriptors: \*Waste water disposal, Waste disposal, \*Waste water treatment, Europe, Water purification, Separation techniques, \*Hogs, \*Farm wastes, Waste treatment.  
Identifiers: \*Romania.

Traditionally, in raising farm animals, the problem of waste disposal has been solved by utilizing the waste in liquid or solid form as agricultural fertilizer. The quantity of waste material that can be so used is limited since the overmanuring of land is unfavorable for crops. There is also the danger that large quantities of pollutants may enter natural waters. In modern pig raising centers comprising herds of 100,000 animals, the litter is evacuated hydraulically, a process that uses 3000-4000 m<sup>3</sup> of water/day. The resulting pollution is equivalent to a town of 200,000-300,000 inhabitants. Such large units usually do not have access to fields large enough (3000-4000 ha) to dump their litter. Dumping the waste water into a river is usually not possible, except after mechanical and biological purification to avoid serious pollution. Technological processes to solve such problems follow in general those of urban water purification plants; these involve separation of solids, settling ponds, chlorination, incineration, dehydrating muds, agricultural uses and composting. The operation of several stations in Rumania is described.—Copyright 1975, Biological Abstracts, Inc.  
W76-13055

**ENVIRONMENTAL CONTROL IN PLANTS AT MINIMUM COST.**  
C. D. Burnham.  
Water and Pollution Control, Vol. 114, No. 6, p 6-8, 9, June, 1976, 4 fig.

Descriptors: \*Water pollution control, \*Industrial wastes, \*Water reuse, \*Design criteria, \*Byproducts, Operations, Economics, Toxicity, Drainage systems, Equipment, Materials, \*Waste water treatment.

Design and operating practices for controlling water pollution from waste treatment operations at a minimum cost are reviewed. The most effective way to eliminate pollution is at the source by means of raw material, process, and/or equipment changes. For example, the use of countercurrent double rinse tanks that require water addition only when the rinse water is too dirty can reduce drainage system requirements in the metal finishing industry. Segregation of drainage systems can be used to avoid the discharge of possible toxic combinations. Site selection is another factor in achieving environmental control at minimum cost; care should be exercised to avoid building a facility on a flood plain. Water reuse is a pollution control technique which also can provide valuable byproducts and an inexpensive source of process water. An example of water reuse in a cresylic acid plant is presented. (Kreager-FIRL)  
W76-13056

**LATEST U. S. SEWAGE REGULATIONS.**  
W. F. Roberts.  
Marine Engineering/Log, Vol. 81, No. 6, p 34-37, June, 1976, 2 fig.

Descriptors: \*Waste water treatment, \*Sewage treatment, \*Biological treatment, \*Sewerage, \*Treatment facilities, \*Regulation, Ships, \*Water quality standards.

Legal terms relating to shipboard sewage treatment are defined. Only sewage and other waste water coming into contact with it are required to be treated. The three basic negative effects of dumping raw sewage from vessels are the visual insult of raw sewage, the health hazard from pathogenic organisms and the pollution problems, such as oxygen depletion of the water. The harmful effects of vessels on the open seas are marginal, but serious problems can be caused in estuaries, bays, rivers, and lakes. Flow-through sewage

treatment is now allowed for all oceangoing vessels. Tests and certification are required for these systems. Possible marine sanitation devices (MSD's) to meet the regulations include a holding tank, vacuum or pressure flushing, total incineration, maceration/chlorination, biological flow-through treatment, physical-chemical flow-through treatment, recycling, and individual unitized toilets. Operational considerations include as much automatic operation as possible, a minimum of sewage treatment skills required, minimum use of expendables, reliability, ease of maintenance, minimizing personnel objections, and elimination of need for shore accommodations. Different systems are more appropriate in different situations. A compilation of manufacturer's information on MSD's is included. (Snyder-FIRL)  
W76-13057

**TWO-DIMENSIONAL WATER QUALITY MODELING AND WASTE TREATMENT OPTIMIZATION FOR WIDE, SHALLOW RIVERS.**  
Wisconsin Univ., Madison.  
For primary bibliographic entry see Field 5B.  
W76-13058

**A BRIEF HISTORY OF SEWAGE TREATMENT - 2 THE ROYAL COMMISSION.**  
For primary bibliographic entry see Field 5G.  
W76-13060

**VIRUSES IN WASTE, RENOVATED, AND OTHER WATERS. 1974 LITERATURE ABSTRACTS.**  
National Environmental Research Center, Cincinnati, Ohio.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-245 957, \$4.00 in paper copy, \$3.00 in microfiche. Report No. EPA-670/9-75-007, June 1975. 39 p. 117 ref. Berg, G. and White, F. D., eds.

Descriptors: \*Chlorination, \*Effluents, \*Waste water, \*Water quality, \*Viruses, \*Water pollution, \*Pollutants, \*Bibliographies, Sewage.

Annotations and/or abstracts of published papers and books on viruses in waste, renovated, and other waters are contained in this bibliography. The 117 references were selected from the world's scientific literature published since 1972. (Sinha-OEIS)  
W76-13095

**PROFESSIONAL BIAS AND WATER REUSE.**  
George Williams Coll., Downers Grove, Ill.  
For primary bibliographic entry see Field 5G.  
W76-13096

**WASTE DISPOSAL IN SEAFOOD PROCESSING: PUBLIC OR PRIVATE.**  
Georgia Univ., Athens. Inst. of Natural Resources.  
R. M. North.

In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 29-36. 7 ref.

Descriptors: \*Fish handling facilities, \*Waste treatment, \*Economic efficiency, Economic impact, Third party effects, Equity, Water quality, Cost sharing, Coastal plains, Water pollution control, Treatment facilities, Effluents, Standards, Legislation.  
Identifiers: \*Seafood processing wastes.

The variables involved in decision making by the coastal seafood processing industry with regard to waste disposal and effluent treatment are discussed in relation to the general aspects of benefit and cost distribution between externalities and economic impact, i.e., attaining efficiency in



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

waste management. Decisions must also be based on the extent of water quality desired, what institutional arrangements are required, and how should the water quality levels adopted be paid for. The stricter federal and state regulations for effluent discharges influence the decision whether to install private treatment facilities or enter into contracts with municipalities; the latter would involve considerations of contractual constraints and the risks of escalating municipal charges; the former would involve escalating construction and operating and maintenance costs and firm's ability to effectively manage the treatment system to avoid penalties or litigation. The dilemma in coastal areas is the question of determining the economically efficient levels of waste treatment to comply with the latest federal water pollution control legislation. The solution lies by the industry and public offices to work out an economically efficient system of seafood waste treatment which fully considers the real demands for water quality, the best institutional arrangements to meet such demands, and the equitable apportionment of costs among the consumers of water quality. (See also W76-09329) (Auen-Wisconsin) W76-13102

**EFFECTS OF CHLORINE AND SULFITE REDUCTION ON LAKE MICHIGAN INVERTEBRATES,**  
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.  
For primary bibliographic entry see Field 5C.  
W76-13113

**SEASONAL VARIATIONS IN THE PURIFICATION OF TREATMENT PLANT EFFLUENT IN NATURAL SAND DEPOSITS,**  
Rensselaer Polytechnic Inst., Troy, N. Y. Fresh Water Inst.  
D. B. Aulenbach, N. L. Clesceri, L. Hajas, and S. Beyer.  
Report FWI 76-1, January 1976. 41 p. 24 fig., 2 tab., 13 ref. EPA R803452-01, DACA 89-74-1637.

**Descriptors:** \*Seasonal, \*Waste Water treatment, \*Efficiencies, \*Sands, \*Tertiary treatment, \*New York, Groundwater, Seepage, Infiltration, Hydrogen ion concentration, Chlorides, Dissolved solids, Dissolved oxygen, Nitrogen, Phosphorus, Alkalinity, Coliforms, Biochemical oxygen demand.  
**Identifiers:** \*Lake George Village(NY), West Brook(NY), Lake George(NY).

Effluents from the Lake George Village Sewage Treatment Plant, New York, were studied to determine if the final treated effluent quality varied seasonally. A deep natural sand deposit near the lake is used for tertiary treatment. Most of the effluent re-emerged from the ground along with additional groundwater. Flow did not vary during fall and winter, but increased in spring due to increased runoff and infiltration; high summer flows occurred during the tourist season. Flows have increased since 1968 when the sewer district was enlarged. Temperature, alkalinity, pH, chlorides, dissolved solids, dissolved oxygen, nitrogen, nitrates, ammonia, and phosphorus were studied seasonally at the various seepage areas and in West Brook which carries the seepage to Lake George. In West Brook, dissolved oxygen, alkalinity, dissolved solids, and chloride levels were high; nitrogen oxidized to nitrate, and phosphorus was reduced to below natural groundwater levels; and coliforms and biochemical oxygen demand levels were extremely low, so that the water is suitable for drinking. The present system provides adequate treatment, even during seasonal stress. Water quality in Lake George is not being strained. Disposal of sewage effluents onto soil provides the equivalent of tertiary treatment, especially for phosphorus removal, at minimum cost. (Buchanan-Davidson-Wisconsin). W76-13121

**THE ROLE OF DESALTING AND BRACKISH WATER RESOURCES IN THE ARID REGIONS OF THE AMERICAS,**  
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.  
For primary bibliographic entry see Field 3A.  
W76-13133

**METHOD AND APPARATUS FOR TREATING LIQUID CONTAMINATED WITH RADIOACTIVE PARTICULATE SOLIDS,**  
Hydromation Filter Co., Livonia, Mich. (Assignee).  
G. Hirs.  
U. S. Patent No. 3,962,078, 8 p, 3 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 753-754, June 8, 1976.

**Descriptors:** \*Patents, \*Waste water treatment, \*Radioactive wastes, Water pollution sources, Nuclear wastes, \*Radioactive waste disposal, Water pollution treatment, Water pollution control, Filtration, Water reuse, Filters, Screens.  
**Identifiers:** Granular filter bed.

A method and apparatus reduces the amount of radioactive solids resulting from the filtration of particulate contaminants from liquid in a nuclear reactor plant. A filtration system includes a pre-filter comprising a sheet filter medium through which the reactor liquid passes to remove relatively large particulate contaminants for storage or disposal. The reactor liquid is then passed through a bed of granular filter medium to accumulate substantially all previously non-filtered contaminants and thereby provide a clarified liquid suitable for reuse in the reactor. Backwash liquid is flowed through the granular filter bed to remove and entrain the accumulated contaminants into a slurry which is received by a reservoir where the slurry is maintained quiescently to settle the contaminants. Removal of liquid from the reservoir concentrates the contaminants for storage or further processing, without the necessity of large quantities of filter aids that would increase the quantity of storage-requiring contaminated solids. (Sinha-OEIS) W76-13142

**SODIUM SULFUR OXIDES WASTES DISPOSAL PROCESS,**  
Industrial Resources, Inc., Chicago, Ill. (Assignee).  
J. M. Dulin, E. C. Rosar, R. B. Bennett, H. S. Rosenberg, and J. M. Genco.  
U. S. Patent No. 3,962,080, 13 p, 12 tab, 5 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 754, June 8, 1976.

**Descriptors:** \*Patents, \*Industrial wastes, \*Waste water treatment, \*Water pollution treatment, Water pollution control, Water softening, Demineralization, Sludge treatment, Sodium compounds, Electric powerplants, Heat treatment, \*Waste disposal.  
**Identifiers:** Sintering, Blow-down sludges.

In preparing water for use as boiler feedwater, makeup water, or in cleaning up condenser water, nuclear reactor coolant water, spent fuel storage water, sump waste water, rad wastes, decontaminating units, and decontamination units, ambient or recirculating water supplies are decontaminated or demineralized to remove various components. Sodium sulfur oxide compounds are produced as by-products from such industrial processes. Still another source of sodium sulfate is that contained in the blowdown from nuclear or fossil fuel fired power plant cooling towers. This patent describes a process which results in reducing the solubility of waste sodium sulfite and sulfate. Alkali metal sulfur oxide compounds are mixed with fly ash, formed into an agglomerate particle, and sintered at temperatures ranging from 1000 - 2300F for a period of time, dependent principally on the specific heat of the mixture. The sintering may

take place under oxidizing or slightly reducing conditions, at sub- or super-atmospheric pressure, although ambient oxidizing and atmospheric pressure conditions are preferred. The agglomerate may be a pellet containing a binder, may be self-bound as with water, or may be briquetted under pressure. The end-product shows reduced solubility of the sodium sulfur oxide compounds, fixing of heavy metal or radioactive components in the ash, reduced volume and increased density. The particle is suitable for use as such an aggregate, e.g., as mulch or road bed fill, or used as an aggregate in a composition such as in concrete, a pozzolan, asphalt, ceramics (bricks). (Sinha-OEIS) W76-13143

**RAIN STORING TANK,**  
G. Nussbaum.  
U.S. Patent No. 3,962,084, 4 p, 18 fig, 13 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 755, June 8, 1976.

**Descriptors:** \*Patents, \*Waste water treatment, \*Water storage, Water pollution treatment, \*Water pollution control, Water quality control, \*Storage tanks, \*Rainwater, Surface runoff, Excess water, Storm drains, Combined sewers, Storm water.

A rainstoring tank of substantially circular design is inserted in a main sewer which leads to the purification plant of a combined-water sewer system. The tank is provided with tangentially entering combined-water channel and a sanitary sewage drain leading from the center of the tank bottom to the purification plant. In dry weather the sanitary sewage flows from the periphery directly to the central drain. However when it starts raining, the combined water shoots, because of its kinetic energy, tangentially into the tank and removes, by rinsing, the polluted sediments from the tank bottom. The tank capacity stores the first, strongly polluted rain water surge and prevents the discharge. Heavier sanitary sewage materials are conveyed, by cyclonic effect, first outward and then, by the superposed toroidal flow, via the tank bottom to the sanitary sewage outlet. While the tank is being increasingly filled up to the relief gate, the flow quiets down and a mechanical purification takes place, so that during persisting rainfall mechanically purified combined water can drain. While the tank is being emptied the flow continues to feed the purification plant uniformly, and the originating eddy or spiral flow assures a sweeping water force sufficient for a thorough cleansing of the tank bottom. (Sinha-OEIS) W76-13145

**IMMERSION FILTER,**  
H. Hartmann.  
U.S. Patent No. 3,962,087, 6 p, 6 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 756, June 8, 1976.

**Descriptors:** \*Patents, \*Waste water treatment, Water pollution treatment, \*Sewage treatment, Water quality control, \*Filtration, Biological treatment, Submergence, \*Filters, Biological membranes, Oxygen, Equipment.  
**Identifiers:** \*Immersion filters.

An immersion percolating filter arrangement for biologically purifying sewage effluent is provided with growth accumulation surfaces adapted to be slowly rotated so that the surfaces are alternately immersed in the sewage effluent and then removed to enrich the biological growth accumulated on it with oxygen. The growth accumulation surfaces are formed from a flexible material which are suspended under tension in planes parallel to one another within a roller cage support structure having end faces which are substantially circular. The end faces of the roller cage support structure are each provided with a bearing arrangement for permitting the rotation of the support structure about the axis of rotation with one of the bearing ar-

rangements being connected to a suitable driving source. The end faces of the roller cage support structure are provided with radial support arms with the free ends of the arms being connected by a rigid connection member extending parallel to the axis of rotation for supporting the flexible material. (Sinha - OEIS)  
W76-13146

**OXIDATION PROCESS FOR IMPROVING THE ENVIRONMENTAL QUALITY OF WATER CONTAINING SULFUR AND/OR INORGANIC SUB-SIX-SULFUR-CONTAINING IMPURITIES**, Chevron Research Co., San Francisco, Calif. (Assignee).

W. Dardenne-Ankring, Jr.  
U.S. Patent No. 3,963,611, 7 p, 1 fig, 2 tab, 4 ref; Official Gazette of the United States Patent Office, Vol 947, No 3, p 1262, June 15, 1976.

Descriptors: \*Patents, \*Waste water treatment, \*Industrial wastes, \*Water pollution treatment, \*Water quality control, \*Oxidation, Sulfur compounds, Temperature, Hydrogen ion concentration.

A water stream is improved by oxidizing sulfur and/or the sulfur content of sub-six-sulfur-containing impurities in the stream to sulfate. In the method, the stream is contacted with molecular oxygen under particular conditions which include an elevated temperature, a substantial oxygen gas partial pressure, a pH of at least 9.6 and the substantial absence of a heavy metal oxidation catalyst. For each gram atom of sub-six sulfur, the contact mixture must contain at least one equivalent of a strong inorganic base such as sodium hydroxide. (Sinha-OEIS)  
W76-13150

**METHOD AND APPARATUS FOR PRECIPITATING COLLOIDS FROM AQUEOUS SUSPENSIONS**,

Canton Textile Mills, Inc., Ga. (Assignee).

J. K. Sullins.

U.S. Patent No. 3,964,991, 3 p, 6 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1720, June 22, 1976.

Descriptors: \*Patents, \*Waste water treatment, \*Industrial wastes, \*Water pollution treatment, \*Water quality control, Colloids, \*Flocculation, Electrolysis, Cathodes, Anodes, Dyes, Equipment, \*Skimming.  
Identifiers: Textile industry.

In order to effectively cause flocculation of suspended colloidal particles, it is necessary to neutralize the electric charges on the particles and simultaneously to establish minuscule gaseous bubbles which attach themselves to the neutralized particles to effect flotation of the particles to the surface where they may readily be skimmed off. This invention utilizes principles of electrolysis effectively by neutralizing the colloidal suspension to a pH of approximately 7. The apparatus is provided which causes effluent containing colloids to be moved along a path which is generally spiral and which imparts a churning and efficient scrubbing action to the surfaces of the cathode and anode. This action is achieved by constructing the cathode in hollow cylindrical form and by constructing the anode of a multi-valent metal in solid cylindrical form and by mounting the anode inside of the cylindrical cathode in such a manner as to define a path between the cathode and anode which is spiral. This controlled movement along the elliptical path inhibits the accumulation of hydrogen and oxygen on the cathode and anode respectively. By keeping the particles small, the attachment of such small particles to the colloidal particles is facilitated. The particles which due to the action of multi-valent cations derived from the anode, are in clusters and are therefore by this means floated to the surface and skimmed away by conventional means in a flotation cell. (Sinha-OEIS)

W76-13159

**OPTIMAL DESIGN OF CHLORINATION SYSTEMS**,

Malviya Regional Engineering Coll., Jaipur (India).

For primary bibliographic entry see Field 5F.

W76-13163

**DYNAMIC PROGRAMMING MODEL FOR WASTEWATER PLANT INVESTMENT**,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

J. M. Armstrong.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 102, No EE5, p 985-1003, October 1976. 14 fig, 2 tab, 12 ref.

Descriptors: \*Sewage treatment, \*Treatment facilities, \*Waste water (Pollution), \*Dynamic programming, \*Decision making, \*Investment, Planning, Engineering, Water quality, Methodology, Equations, Capital costs, Operating costs, Technology, Systems analysis, Mathematical models.

Identifiers: \*Capacity expansion, Cost minimization.

The problem of wastewater treatment plant capacity is examined. A decision model, which utilizes a dynamic programming formulation, is developed which generates optimum plant capacity expansion strategies. The model allows for variation in available treatment technology, capital and operating costs, demand based on different population projections, and changes in construction and labor cost indices. The methodology of the model is readily usable by managers and decision makers interested in exploring short-term or long-term plant expansion programs. Comparison with other research on capacity expansion is made and the model is found consistent with previous theoretical results. (Bell-Cornell)  
W76-13164

**OPTIMAL DESIGN OF WASTEWATER COLLECTION SYSTEMS**,

Roorkee Univ. (India).

J. M. Gupta, S. K. Agarwal, and P. Khanna.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, p 1029-1041, Vol 102, No EE5, October 1976. 7 fig, 3 tab, 13 ref.

Descriptors: \*Sewage treatment, \*Waste water (Pollution), \*Optimization, \*Design, Computers, Hydraulic models, Economics, Constraints, Equations, Algorithms, Systems analysis.

Identifiers: \*Cost minimization, \*Waste water collection, Nonlinear programming, Global optimum.

The most sought-after requirements of an optimization algorithm are with respect to computer time and memory. For the six-link system, the time required for execution of a program is 70 seconds on an IBM-360 (Model No. 44) computer, indicating that the algorithms are fast converging. Further, it takes only 75 seconds to compile and load the program on a disk. The requirement of storage space is also very small. The total memory requirement on this computer is 9E8 bytes. A nonlinear algorithm based on Powell's method of conjugate directions is developed to optimize the design of wastewater collection systems. The algorithm is fast converging, requires small computer memory, employs the discrete set of commercially available diameters, and leads to a global optimum. The economics of optimal and conventional designs is compared for a six-link wastewater collection system at Roorkee, India. Also, a parametric study is presented. (Bell-Cornell)  
W76-13165

**DESIGNING REGIONALIZED WASTE WATER TREATMENT SYSTEMS**,

Ohio State Univ., Columbus. Department of Civil Engineering.

E. E. Whitlatch, Jr. and C. S. ReVelle.

Water Resources Research, Vol. 12, No. 4, p 581-591, August 1976. 13 fig, 1 tab, 22 ref.

Descriptors: \*Waste water treatment, \*Treatment facilities, \*Estuaries, \*Optimization, \*Economics, \*Design, \*Water quality control, Regions, Sewage treatment, Rivers, Costs, Piping, Pumping, Dissolved oxygen, Dynamic programming, Linear programming, Equations, Algorithms, Alternative planning, Management, Mathematical models, Systems analysis.

Identifiers: Cost minimization, Heuristic location techniques, \*Delaware Estuary.

The problem of determining the optimal number, location, and level of treatment for regional domestic sewage treatment plants along an estuary or river is considered. The formulation is one of minimizing the sum of treatment and transport (piping and pumping) costs such that water quality improvement goals for dissolved oxygen are met. Restrictions may also be placed upon the overall level of treatment (required secondary, required uniform, or least cost) if desired. An optimization procedure is developed which utilizes dynamic programming, linear programming, and heuristic location techniques in a series of steps which lead to progressively improved (lower total cost) solutions. The location procedure is intended for use by an engineer-planner during the design stage and requires his participation and skilled judgment during the course of the algorithm. The technique is illustrated for the Delaware estuary for 22 domestic waste sources, nine potential regional sewage treatment plant sites, and 22 industrial waste sources. Results of the case study show considerable savings over previous nonregional treatment schemes. (Bell-Cornell)  
W76-13166

**SANITARY LANDFILL STABILIZATION WITH LEACHATE RECYCLE AND RESIDUAL TREATMENT**,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

For primary bibliographic entry see Field 5E.

W76-13187

**CHARACTERISTICS OF BOATS AS SOURCES OF SEA POLLUTION, (IN RUSSIAN)**,

Scientific Research Inst. of Water Transport Hygiene, Moscow (USSR).

For primary bibliographic entry see Field 5B.

W76-13191

## 5E. Ultimate Disposal of Wastes

**LAND APPLICATION OF WASTEWATER, (LITERATURE REVIEW)**,

New York State Dept. of Environmental Conservation, Albany.

For primary bibliographic entry see Field 5D.

W76-12676

**INTER-RELATION OF KEY-FACTORS FOR INFILTRATION OF LIQUID DOMESTIC WASTE INTO SOIL**,

Connecticut Univ., Storrs.

For primary bibliographic entry see Field 5D.

W76-12679

**SLUDGE PROCESSING, TRANSPORTATION AND DISPOSAL/RESOURCE RECOVERY: A PLANNING PERSPECTIVE**,

Environmental Protection Agency, Washington, D.C. Div. of Water Planning.

For primary bibliographic entry see Field 5D.

W76-12683

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5E—Ultimate Disposal Of Wastes

**ATLANTIC RICHFIELD HANFORD COMPANY, QUARTERLY REPORT, TECHNOLOGY DEVELOPMENT FOR LONG-TERM MANAGEMENT OF HANFORD HIGH-LEVEL WASTE, JULY 1975 THROUGH SEPTEMBER 1975.**

Atlantic Richfield Hanford Co., Richland, Wash. Advanced Waste Engineering Dept.  
For primary bibliographic entry see Field 5D.  
W76-12684

**FEASIBILITY OF MICROBIAL DECOMPOSITION OF ORGANIC WASTES UNDER CONDITIONS IN DEEP WELLS,**  
Oklahoma State Univ., Stillwater. Dept. of Microbiology.  
For primary bibliographic entry see Field 5D.  
W76-12688

**INTERIM SOLIDIFICATION OF SRP WASTE WITH SILICA, BENTONITE, OR PHOSPHORIC ACID,**  
Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.  
For primary bibliographic entry see Field 5D.  
W76-12690

**CHEMICAL WASTE LAND DISPOSAL FACILITY DEMONSTRATION GRANT APPLICATION.**  
Barr Engineering Co., Minneapolis, Minn.  
For primary bibliographic entry see Field 5D.  
W76-12699

**OPERATIONS MANUAL ANAEROBIC SLUDGE DIGESTION,**  
Stevens, Thompson and Runyan, Inc., Portland, Oreg.  
For primary bibliographic entry see Field 5D.  
W76-12700

**ACID DIGESTION OF COMBUSTIBLE WASTES: A STATUS REPORT,**  
Hanford Engineering Development Lab., Richland, Wash.  
For primary bibliographic entry see Field 5D.  
W76-12776

**A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE 'WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE'.**  
Systems Technology Corp., Dayton, Ohio.  
For primary bibliographic entry see Field 5D.  
W76-12854

**REST AREA WASTEWATER TREATMENT AND DISPOSAL,**  
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-12855

**ECONOMICAL RESIDENTIAL PRESSURE SEWER SYSTEM WITH NO EFFLUENT,**  
SIECO, Inc., Columbus, Ind.  
For primary bibliographic entry see Field 5D.  
W76-12861

**ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES—MIDDLE ATLANTIC BIGHT.**  
Environmental Protection Agency, Annapolis, Md. Annapolis Science Center.  
For primary bibliographic entry see Field 5B.  
W76-12875

**AWT ENERGY NEEDS - A PRIME CONCERN,**  
Orange County Water District, Fountain Valley, Calif. Board of Directors.

For primary bibliographic entry see Field 5D.  
W76-12919

**MOGDEN, WHERE SEWAGE WORKS,**  
For primary bibliographic entry see Field 5D.  
W76-12923

**FATE OF METALS IN WASTEWATER DISCHARGE TO OCEAN,**  
CDM, Inc., Pasadena, Calif.  
For primary bibliographic entry see Field 5B.  
W76-12927

**FREEZE TREATMENT OF ALUM SLUDGE,**  
Envirotech Corp., Salt Lake City, Utah. EIMCO BSP Div.  
J. H. Wilhelm, and C. E. Silverblatt.  
American Water Works Association Journal, Vol. 68, No. 6, p 312-314, June, 1976. 5 fig, 1 tab, 1 ref.

Descriptors: \*Sludge treatment, \*Freezing, \*Sludge, \*Dehydration, \*Dewatering, Treatment facilities, Drainage, Refrigeration, Operating costs, Landfills.  
Identifiers: \*Alum sludge, Natural freezing, \*Freeze treatment.

Improving sludge characteristics by freeze treatment and application of the method to difficult sludge situations were studied. The sludge particles are dehydrated when the water closely associated with them freezes. After thawing, the particles retain the new sizes and shapes produced by dehydration, and the consequent rapid dewatering properties. The sludge must be frozen completely for a sufficient length of time to dehydrate the particles. Freeze treatment is sometimes followed by thickening and drying steps, but the drainage properties of the treated solids are so good that the treated slurry could be sent directly to a lagoon or drying bed. Natural freezing could be used in cold climates in winter if the sludge is completely frozen and the treated solids can be conveniently harvested after thawing. The refrigeration equipment for freeze treatment is relatively maintenance-free and operates continuously without operator attention. The electric power to operate such a unit often costs the same or less than the pre-treatment chemicals that would be required for other treatment methods. Freeze treatment is effective for any sludge quality. Because no chemical conditioners or additives are used, they cannot leach into ground water when the sludge is used as land fill. The freeze-treated sludge alone can support vegetation. Because this sludge retains its good dewatering and drainage properties indefinitely, it will not become gelatinous and cause drainage problems in a land-fill operation. (Snyder-FIRL)  
W76-12928

**CHEMICAL AND PLANT EXTRACTABILITY OF METALS AND PLANT GROWTH ON SOILS AMENDED WITH SLUDGE,**  
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.  
For primary bibliographic entry see Field 5B.  
W76-12929

**SANITARY LANDFILL LEACHATES AND THEIR TREATMENT,**  
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-12930

**SOLID WASTES AND WATER QUALITY, (LITERATURE REVIEW),**  
Environmental Protection Agency, Washington, D. C. Wastewater Research Div.  
J. A. Heidman, and D. R. Brunner.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1299-1305, June, 1976. 40 ref.

Descriptors: \*Solid wastes, \*Waste disposal, \*Water quality, \*Landfills, \*Leachate, Groundwater, Water pollution, Sludge, Municipal wastes, Industrial wastes, Waste treatment, Design criteria, Monitoring, Analytical techniques, Materials, Reviews, \*Bibliographies.  
Identifiers: \*Literature review.

A review of literature dealing with the effect of solid waste disposal on water quality is presented. Topics covered include: factors affecting leachate formation and control, a numerical procedure for evaluating the environmental impact associated with land disposal, the use of earth resistivity surveys to define groundwater contamination, techniques for monitoring landfill sites, the chemical characteristics of two leachate plumes near oil landfills, the groundwater quality underlying landfill in Alaska, the design of a demonstration landfill in an area with very high groundwater, analytical procedures for leachate composition studies, an evaluation of the combined disposal of waste water sludges and municipal refuse in a sanitary landfill, leachate management alternatives, materials used for containing leachates at sanitary landfill sites, the design of an experimental papermill sludge landfill, and the design and operation of an on-site leachate collection, treatment, and disposal facility at a landfill site. (Kreager-FIRL)  
W76-12933

**PRELIMINARY ASSESSMENT OF SYSTEMS FOR DERIVING LIQUID AND GASEOUS FUELS FROM WASTE OR GROWN ORGANICS,**  
National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.  
For primary bibliographic entry see Field 5D.  
W76-12967

**SEWAGE EFFLUENT TURNED TO SNOW: PROVIDES STORAGE, REMOVES POLLUTANTS,**  
Wright-McLaughlin Engineers, Denver, Colo.  
For primary bibliographic entry see Field 5D.  
W76-13048

**PRESENT-DAY AND FUTURE PROBLEMS CONCERNING THE PURIFICATION OF WATER USED IN RAISING PIGS, (IN FRENCH),**  
Institutul de Studii, Cercetari si Proiectari Pentru Gospodaria, Bucharest (Romania).  
For primary bibliographic entry see Field 5D.  
W76-13055

**WASTE DISPOSAL IN SEAFOOD PROCESSING: PUBLIC OR PRIVATE,**  
Georgia Univ., Athens. Inst. of Natural Resources.  
For primary bibliographic entry see Field 5D.  
W76-13102

**METHOD AND APPARATUS FOR TREATING LIQUID CONTAMINATED WITH RADIOACTIVE PARTICULATE SOLIDS,**  
Hydromat Filter Co., Livonia, Mich. (Assignee).  
For primary bibliographic entry see Field 5D.  
W76-13142

**SODIUM SULFUR OXIDES WASTES DISPOSAL PROCESS,**  
Industrial Resources, Inc., Chicago, Ill. (Assignee).  
For primary bibliographic entry see Field 5D.  
W76-13143



## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Treatment and Quality Alteration—Group 5F

**SANITARY LANDFILL STABILIZATION WITH LEACHATE RECYCLE AND RESIDUAL TREATMENT**, Georgia Inst. of Tech., Atlanta. School of Civil Engineering. F.G. Pohland.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 524, \$5.50 in paper copy, \$3.00 in microfiche. Report No. EPA-600/2-75-043, October 1975. 105 p, 31 fig, 23 tab, 46 ref. EPA R-801397.

**Descriptors:** \*Waste disposal, \*Landfills, \*Sludge disposal, Waste treatment, Aerobic treatment, Anaerobic digestion, Leachate, Leaching, Wastes, Solid wastes, Activated carbon, Hydrogen ion concentration, Organic wastes.

**Identifiers:** \*Leachate recirculation, Leachate treatment, Landfill stabilization.

Results of an experimental system for study of landfill disposal of approximately 0.3 cu m (10 cu ft) of domestic refuse were provided. The study evaluated not only traditional landfill decomposition as represented by single pass of water originating from rainfall but also recirculation of the collected leachate. Sewage sludge addition to the solid waste and pH control of the recirculated leachate were also evaluated. Biological and physical-chemical methods for treatment of leachates, especially those derived from the stabilized solid waste undergoing leachate recirculation, were also evaluated. Analysis of about 3 years of data indicated that leachate recirculation was very beneficial in accelerating the removal of at least the readily available organics from the refuse and leachate. This rate of removal, accomplished over a period of months for the recirculated units as compared to the traditional, single pass unit, was further enhanced by the initial addition of sewage sludge and by pH control. The leachate treatment studies indicated that either aerobic or anaerobic biological processes successfully remove leachate organics and that the effluent residuals could be polished by activated carbon adsorption and/or ion exchange either separately or in combination. (Sims-ISWS) W76-13187

### 5F. Water Treatment and Quality Alteration

**A HYPOTHESIS OF ION FILTRATION IN A POTABLE-WATER AQUIFER SYSTEM**, Geological Survey, Austin, Tex. For primary bibliographic entry see Field 4B. W76-12803

**AUTOMATION OF WATER SUPPLY SYSTEMS**, TenEch Environmental Services, Inc., South Bend, Ind. W.F. Echelberger, Jr., B. P. J. Higgins, M. W. Tenney, and D. C. Withey. Available from the National Technical Information Service, Springfield, VA 22161, as AD-A-008 990, \$10.00 in paper copy, \$3.00 in microfiche. Army Construction Engineering Research Laboratory, Champaign, Illinois, Technical Report E-54, March 1975. 340 p, 91 fig, 168 ref, 6 append. Army DACA 23-71-0020.

**Descriptors:** \*Automatic control, \*Water treatment, \*Water supply, Water quality, Filtration, Coagulation, Flocculation, Sedimentation, Water softening, Iron, Manganese, Taste, Odor, Sludge disposal, Disinfection, Automation, Equipment, Control, Treatment, Reviews.

This report provided an engineering evaluation of the capabilities of various commercially available water quality sensing devices and automated control systems adapted to water treatment plant operation. This state-of-the-art survey was accomplished through a review of technical journals; communications with experienced consulting en-

gineers, regulatory agency personnel, and treatment plant superintendents; and on-site observations of equipment operation. (Sims-ISWS) W76-12817

**A VIRUS-IN-WATER STUDY OF FINISHED WATER FROM SIX COMMUNITIES**, Health Effects Research Lab., Cincinnati, Ohio. Water Quality Div. For primary bibliographic entry see Field 5A. W76-12866

**THE ENVIRONMENTAL IMPACT OF WATER CHLORINATION**, Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5C. W76-12876

**CURRENT CHLORINATION AND DECHLORINATION PRACTICES IN THE TREATMENT OF POTABLE WATER, WASTE-WATER, AND COOLING WATER**, For primary bibliographic entry see Field 5D. W76-12877

**CHLORINATION OF ORGANICS IN DRINKING WATER**, Municipal Environmental Research Lab., Cincinnati, Ohio. Water Supply Research Div. For primary bibliographic entry see Field 5C. W76-12881

**THE POTENTIAL FOR INCREASED MUTAGENIC RISK TO THE HUMAN POPULATION DUE TO THE PRODUCTS OF WATER CHLORINATION**, Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5C. W76-12887

**THE EPIDEMIOLOGIC APPROACH TO THE EVALUATION OF WATER-BORNE CARCINOGENS**, National Cancer Inst., Bethesda, Md. For primary bibliographic entry see Field 5C. W76-12888

**MICROBIOLOGY - DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES, (LITERATURE REVIEW)**, Environmental Research Center, Cincinnati, Ohio. For primary bibliographic entry see Field 5A. W76-12896

**STUDY ON THE EFFICIENCY OF FOUR PROCEDURES FOR ENUMERATING COLIFORMS IN WATER**, Canada Centre for Inland Waters, Burlington (Ontario). For primary bibliographic entry see Field 5A. W76-12897

**HYGIENIC EVALUATION OF THE QUALITY OF WATER DESALINATED IN INDUSTRIAL ELECTRODIALYSIS INSTALLATIONS UNDER CONDITIONS OF COUNTRY SETTLEMENTS, (IN RUSSIAN)**, Meditsinskii Institut Saratov (USSR). E. V. Shtannikov, A. M. Akimov, G. I. Rozhnov, and A. A. Orlov. Gig Sanit. 38(1), p 23-27, 1973.

**Descriptors:** Public health, \*Desalination, Water quality standards, \*Potable water, \*Electrodialysis, \*Water treatment.

Water desalinated in industrial electrodialysis installations satisfied hygienic requirements for drinking water quality. The desalinated water left

no unpleasant taste after its use and was assessed as adequate for human domestic and drinking purposes.—Copyright 1975, Biological Abstracts, Inc. W76-12910

**DISINFECTION, (LITERATURE REVIEW)**, Georgia Inst. of Tech. Atlanta. School of Civil Engineering. A. W. Hoadley, and J. Gould. Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1166-1170, June, 1976. 45 ref.

**Descriptors:** \*Disinfection, \*Potable water, \*Waste water treatment, \*Water purification, Chlorination, Ozone, Ultraviolet radiation, Bacteria, Viruses, Organic compounds, Chlorine, Coliforms, Enzymes, Analytical techniques, Aerobic treatment, Reviews, \*Bibliographies, \*Water treatment.

**Identifiers:** \*Literature reviews.

A literature survey of papers dealing with the disinfection of water is presented. Specific topics discussed include: methods for the measurement of residual chlorine, the formation of chlorinated organic compounds in chlorinated drinking water and waste water, the effect of chlorine on the enzymes of *Escherichia coli*, the combined effect of ozone and sonication on the inactivation of pathogenic and non-pathogenic bacteria in secondary waste water effluent, reduction in bacterial count during thermophilic aerobic digestion, the effectiveness of glutaraldehyde for virus deactivation, the use of ultraviolet light for virus deactivation, and procedures for testing and comparing different disinfectants. (Kreager-FIRL) W76-12924

**PHOSPHORUS REDUCTION WITH BIVALENT IRON SULFATE AT THE KAPPALA WATER PURIFICATION PLANT, (IN SWEDISH)** Kappalaverket, Lidings (Sweden). For primary bibliographic entry see Field 5D. W76-12989

**VIRUSES IN WASTE, RENOVATED, AND OTHER WATERS. 1974 LITERATURE ABSTRACTS**, National Environmental Research Center, Cincinnati, Ohio. For primary bibliographic entry see Field 5D. W76-13095

**APPARATUS FOR SOFTENING HARD WATER**, Maruyama Mfg. Co. Ltd., Tokyo (Japan). (Assignee). Y. Fukukawa. U.S. Patent No. 3,962,089, 7 p, 22 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 757-758, June 8, 1976.

**Descriptors:** \*Patents, \*Water treatment, \*Water purification, \*Water softening, Water quality, Demineralization, Hardness(Water), Ion exchange, Resins, Equipment, Valves.

An apparatus for softening hard water is described. A raw water pipe, a soft water pipe, a discharge pipe and a salt water pipe are connected with a cylindrical valve seat equipped on a softening tank accommodating a layer of ion-exchange resin. A rotary valve is installed in the cylindrical valve seat and is provided with a passage through which the raw water pipe, soft water pipe and discharge pipe can be separately connected with a water pipe erected through the ion-exchange resin layer. Through rotation of the rotary valve, the combinations of (1) a raw water pipe and soft water pipe, (2) raw water pipe and discharge pipe and (3) salt water pipe and discharge pipe can be alternately connected with the softening tank. A controlling circuit is provided with a floating switch installed in the softening tank, so that when the water level in the softening tank descends

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5F—Water Treatment and Quality Alteration

below a predetermined level the switch works to rotate the motor and automatically displace the rotary valve from the position for stopping the operation to the position for softening, and as a result, there is no fear of overflow of the softening tank to be caused by excessive supply of soft water, and a fixed amount of soft water necessary for the operation can be always secured. (Sinha-OEIS)  
W76-13147

**SEPARATOR.**  
Daicel, Ltd., Tokyo (Japan). (Assignee).  
K. Ishii, and T. Kubo.  
U.S. Patent No. 3,962,096, 4 p, 3 fig, 2 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 759-760, June 8, 1976.

Descriptors: \*Patents, \*Water purification, \*Water treatment, \*Water pollution treatment, Water pollution control, Semipermeable membranes, \*Reverse osmosis, Membrane processes, \*Separation techniques.

An apparatus for separating solutes from water by a reverse osmosis process is described. A separating element is constructed by forming two layers of a semipermeable film into an envelope. A lining capable of allowing the passage of the permeated liquid and also sufficiently rigid to support the inner surfaces of the film layers when the cleaning member is pressed against the outer surfaces is inserted between the two layers of the envelope. One end of the envelope is connected with a collecting pipe having small bores to collect the water which has passed through the semipermeable film into the internal compartment of the envelope containing the lining. The periphery of the envelope is tightly sealed. A corrugated spacer is placed on the envelope and the spacer and envelope are wound in a spiral fashion around the collecting pipe. The ridges and grooves of the spacer define channels which extend parallel to the longitudinal axis of the collecting pipe. The opposite edges of the spacer have notches to provide communication between adjacent channels so that the water to be treated, as well as objects for cleaning the film, can move from one channel to the next in series. The tubular separating element or cartridge thus obtained is placed in a pressure vessel. (Sinha-OEIS)  
W76-13148

**SYSTEM OF WATER PURIFICATION AND PRODUCT DISTRIBUTION.**  
C. W. Gossett, and W. J. Dauenhauer.  
U. S. Patent No. 3,963,612, 4 p, 7 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 947, No 3, p 1262, June 15, 1976.

Descriptors: \*Patents, \*Water purification, \*Water treatment, \*Reverse osmosis, \*Domestic water, Hydraulic properties, Reservoirs.

A system of water purification and distribution employs a movable mounted reverse osmosis module that moves in response to the hydraulic pressure differential created on opposite sides of it during the operation of the system. It is especially devised for home use. A vessel having a relatively large interior chamber for housing the principal components has an inlet connected with a conventional water service line as well as an outlet for discharging nearly pure product water. A stationary upright cylinder secured to the bottom of the vessel and a reciprocable reverse osmosis module are within the chamber. The hydraulic differential pressure on the opposite sides of the chamber controls the supply of raw water from the water service line. A cup reservoir connected to the outlet of the reverse osmosis module holds a replenishable supply of nearly pure product water and is connected to a valve-controlled water distribution line. (Sinha - OEIS)  
W76-13151

**NOVEL POLYMER MEMBRANES FOR REVERSE OSMOSIS.**  
Babcock and Wilcox Ltd., London (England). (Assignee).  
W. M. Muir.

U. S. Patent No. 3,963,618, 8 p, 6 ref; Official Gazette of the United States Patent Office, Vol 947, No 3, p 1264, June 15, 1976.

Descriptors: \*Patents, \*Water purification, \*Membranes, \*Reverse osmosis, Osmosis, Membrane processes, Organic compounds, Filtration, Separation techniques, Resins.  
Identifiers: Polyvinyl co-acetal resin, Ultra-filtration.

A series of organic polymers are described which, when cast in the form of membranes, are useful in the fields of osmosis, reverse osmosis, ultra-filtration and related techniques. In different aspects the invention includes the new polymers and methods of making them, membranes incorporating the polymers and methods for making them, apparatus utilizing the new membranes for liquid purification and separation, and methods of so treating liquids. In general as thin a membrane as possible is produced which still has sufficient mechanical strength to be usable. Further variations can be made in the casting technique to vary the structures of the membranes. Membranes produced by the methods of this invention can be incorporated into standard modules or apparatus for water purification. Osmotic pressure can be very high and so for reverse osmosis applications and hyperfiltration under pressure, the membrane needs to be supported on a rigid porous matrix. (Sinha-OEIS)  
W76-13153

**APPARATUS FOR THE PREVENTION OF SCALING IN DESALINATION APPARATUS.**  
Commissariat a l'Energie Atomique, Paris (France); and Compagnie des Salins du Midi et des Salines de l'Est, Paris (France). (Assignee).  
For primary bibliographic entry see Field 3A.  
W76-13154

**PRESENCE OF INSECTICIDES IN SURFACE WATERS AFTER CONDITIONING TREATMENT, (IN ITALIAN).**  
Camerino Univ. (Italy). Istituto di Igiene.  
M. G. Pellegrini, and M. Cocchioni.  
Boll Soc Ital Biol Sper. 50(15), p 1138-1142, 1974(1975).

Descriptors: \*Water pollution sources, Italy, \*Artificial lakes, Lakes, \*Surface waters, \*Insecticides, \*Flocculation, \*Water pollution treatment, \*Water purification, Filtration, Chlorination, Potable water, Analytical techniques, Gas chromatography, DDD, DDE, DDT, Dieldrin.

Surface waters from a man-made lake in the district of Marche, Italy, are purified by flocculation with aluminum sulfate, filtration and chlorination, resulting in almost total bacterial removal, efficiently reducing organic material and generating potable water. Gas chromatography was used to determine Lindane, Heptachlor epoxide, p,p'-DDE, Dieldrin, p,p'-DDD and p,p'-DDT in the waters before and after passage through the purification plants. The insecticides increased in the raw river water in July and Oct. (probably because increased rainfall washed insecticide from the soil). The purification plant reduced insecticides considerably particularly when the water was most turbid. Typical figures in micrograms per liter are DDT 0.042 and 0.10; Dieldrin 0.0197 and 0.117; Lindane 0.0138 and 0.0050.—Copyright 1976, Biological Abstracts, Inc.  
W76-13160

**DETERMINATION OF SODIUM FORM WATER SOFTENER BREAKTHROUGH.**  
Beckman Instruments, Inc., Fullerton, Calif. (Assignee).  
D. M. Chisdes.  
U.S. Patent No. 3,964,999, 4 p, 2 fig, 6 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1723, June 22, 1976.

Descriptors: \*Patents, \*Water quality control, \*Water treatment, \*Water purification, Water softening, Demineralization, Ion exchange, Hardness(Water), Conductivity, Reverse osmosis, \*Ions, \*Pollutant identification.  
Identifiers: Divalent ions, Monovalent ions, Sodium ions.

In water softening, utilizing the zeolite or ion exchange process, divalent or hardness, calcium and magnesium ions are replaced by monovalent ions. In the case of a sodium form water softener the hardness ions are replaced by sodium ions. This leaves a product water or outflow from the water softener that has a very slight conductivity difference from the hard water feed. The invention provides a system for detecting exhaustion of a water softener and controlling the regeneration which does not depend upon a high degree of sensitivity in the measurement of product conductivity. The softened water product or outflow is subjected to means for discriminating between monovalent and divalent ions. This is done by differentially rejecting monovalent and divalent ions from the product water by means of a reverse osmosis unit. Conductivity is measured both before and after the product has flowed through the reverse osmosis unit and the two conductivities are compared. When the water softener has become exhausted the difference between the two conductivities becomes much greater. (Sinha-OEIS)  
W76-13161

**OPTIMAL DESIGN OF CHLORINATION SYSTEMS.**  
Malviya Regional Engineering Coll., Jaipur (India).  
M. L. Tikhe.  
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 102, No EE5, p 1019-1028, October 1976. 7 fig, 1 tab, 12 ref.

Descriptors: \*Water pollution control, \*Waste water(Pollution), \*Mathematical models, \*Chlorination, Environmental engineering, Optimization, Costs, Organic compounds, Time, Economics, Equations, Systems analysis.  
Identifiers: \*Chlorine compounds, Contacting, \*Cost minimization.

A mathematical model has been developed to calculate the chlorine dose required for a desired percentage kill of organisms while keeping the total cost of the process at minimum. The model developed is general and applicable for water as well as wastewater. An example has been worked out to illustrate the use of equations proposed. The optimum chlorine dose is not only a function of various constants and cost of chlorine but also the volume to be treated. The optimal cost of chlorination increases with the increase in percentage kill of organisms. (Bell-Cornell)  
W76-13163

### 5G. Water Quality Control

**A NON-LINEAR PROGRAMMING MODEL FOR EVALUATING WATER SUPPLY POLICIES IN THE TEXAS COASTAL ZONE.**  
Texas Univ. at Austin.  
For primary bibliographic entry see Field 6D.  
W76-12680

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

#### AN EVALUATION OF TWO HYDROGRAPH SEPARATION METHODS OF POTENTIAL USE IN REGIONAL WATER QUALITY ASSESSMENT.

Oak Ridge National Lab., Tenn.  
D. D. Huff, and C. L. Begovich.  
Available from the National Technical Information Service, Springfield, VA 22161, as ORNL/TM-5258, \$5.50 in paper copy, \$3.00 in microfiche. Report ORNL/TM-5258, March 1976, 112 p, 9 fig, 6 tab, 4 ref, 3 append. W-7405-eng-26.

Descriptors: Hydrology, \*Model studies, Hydrologic data, \*Separation techniques, \*Water quality, \*Hydrographs, \*Water quality standards, Regions.

One of the hydrograph separation methods which was evaluated was the quick-flow method developed at Coweeta Hydrologic Laboratory. This method assumes that quick flow may be separated from delayed flow by a straight line of arbitrary slope. The second method uses rainfall data to define storm events and then separates stormflow from baseflow by projecting a baseflow recession curve during the storm event. The two methods were evaluated on their conceptual basis, ease of application, cost of data processing, and acceptability of results. On the basis of this evaluation, the quick flow method was favored for use in regional assessment. (Chilton-ORNL) W76-12691

#### STUDY OF FEDERAL WATER QUALITY MONITORING EFFICIENCY.

Enviro Control, Inc., Rockville, Md.  
A. Hershaft.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-246 221, \$6.75 in paper copy, \$3.00 in microfiche. Report to Council on Environmental Quality, Washington, D.C. March 1975. 150 p, 2 fig, 7 tab, 22 ref, append. EQ4AC014.

Descriptors: \*Water quality standards, \*Monitoring, \*Reviews, Efficiencies, \*Pollutant identification, Water pollution control.

The study seeks to improve the effectiveness and efficiency of water quality monitoring through a critical review and analysis of pertinent Federal policies and practices. The overview includes reports on the nature and objectives of monitoring, data collection requirements, and processing and dissemination requirements and makes recommendations in these areas. These recommendations include improved record keeping, evaluations of programs on the basis of cost effectiveness, incorporation of adequate analytical quality control procedures, biological monitoring and bottom sediments analysis, use of remote sensing techniques, and cataloging of all water quality monitoring activities. (Chilton-ORNL) W76-12697

#### DEVELOPMENT OF A STUDY PLAN FOR DEFINITION OF PCBs USAGE, WASTES, AND POTENTIAL SUBSTITUTION IN THE INVESTMENT CASTING INDUSTRY.

Versar, Inc., Springfield, Va.  
J. D. Barden, and R. L. Durfee.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 842, \$4.00 in paper copy, \$3.00 in microfiche. Report EPA 560/6-76-007, January 1976, 35 p, 3 fig, 7 ref. EPA No. 68-01-3259.

Descriptors: \*Polychlorinated biphenyls, \*Toxicity, Toxins, Alternative planning, Wastes. Identifiers: \*Polychlorinated terphenyls.

This final report of a study plan designed to define the usage of polychlorinated biphenyls and terphenyls (PCT) reviews the current knowledge and presents methods of information gathering and data sources. Filler substitutes and the use of

unfilled waxes are suggested as two general alternatives to deca-chlorobiphenyl and PCTs. There appear to be no technical barriers to discontinuation of deka and PCTs as fillers but the use of alternatives may increase product cost on the order of 10%. An approach to comparison of alternatives based on technical factors and toxicology data is presented. (Chilton-ORNL) W76-12713

#### TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: OCTOBER - DECEMBER 1974.

Mound Lab., Miamisburg, Ohio.  
C. J. Kershner.  
MLM-2217, August 1975, 23 p, 3 tab, 6 fig, 21 ref. E-33-1-GEN-53.

Descriptors: Reviews, \*Tritium, \*Control systems, Effluents, \*Waste treatment, Pollution abatement, Treatment facilities.

A progress report is presented for the tritium emission control effort initiated at Mound Laboratory in 1972. The installation of a pilot scale cryogenic adsorbate separation system is reported to have progressed beyond 50% completion. Hydrogen gettering is being investigated and it was found that HIP alloy sorption capacity at room temperature was 2.2 wt. %. HIP alloy preferentially sorbs hydrogen in the presence of air. The possibilities of tritium decontamination by molecular excitation were investigated. Selective photodissociation of HTO in the presence of hydrogen was the best scheme for tritium removal. Three additional organic materials, dimethylformamide, dimethylacetamide, and ethoxyethylacetate, were evaluated for use in an extractive distillation system. A computer program has been developed for calculating operating and design parameters for catalytic exchange enrichment and stripping of tritiated water. (Chilton-ORNL) W76-12781

#### TRITIUM EFFLUENT CONTROL PROJECT, PROGRESS REPORT: APRIL - JUNE 1975.

Mound Lab., Miamisburg, Ohio.  
C. J. Kershner, and J. C. Bixel.  
MLM-2270, November 1975, 13 p, 1 fig, 6 ref. E-33-1-GEN-53.

Descriptors: Reviews, \*Control systems, \*Tritium, Effluents, Liquid wastes, \*Waste treatment, Treatment facilities, Equipment, Pollution abatement.

The original Tritium Effluent Control Project initiated in 1972, which was directed to gaseous emissions, has expanded to include liquid tritium wastes. Presently the major development effort is in this area. The major effort in the quarter reported upon here has been directed toward procurement of the equipment needed to perform feasibility experiments on water detritiation. Fabrication of an experimental catalytic water detritiation system was completed by Engelhard Minerals and Chemicals Corporation and will be installed at Mound Laboratory. (Chilton-ORNL) W76-12782

#### TORTUGUERO BAY ENVIRONMENTAL STUDIES.

Puerto Rico Nuclear Center, Mayaguez.  
For primary bibliographic entry see Field 6G. W76-12783

#### ECONOMIC EVALUATION OF THE PROMULGATED INTERIM PRIMARY DRINKING WATER REGULATIONS.

Energy Resources Co., Inc., Cambridge, Mass.  
J. E. Alpert, and D. Harrington.  
Available from the National Technical Information Service, Springfield VA 22161 as PB-248 588, \$9.25 in paper copy, \$3.00 in microfiche. Report

No. EPA-570/9-75-003, October 1975. 276 p, 4 fig, 70 tab, 73 ref, 8 append. EPA No. 68-01-2865.

Descriptors: Evaluation, \*Water treatment, \*Costs, \*Economics, Unit costs, Potable water, Monitoring, \*Regulation, Water costs, Water supply, Annual costs, Cost comparisons, Cost analysis, Municipal water, \*Water quality standards. Identifiers: \*Drinking water regulations.

An evaluation was performed of the Promulgated Interim Primary Drinking Water Regulations. The results of this study indicated the following: The annual costs for water monitoring for community systems will be between \$12 million and \$25 million, while the costs for water monitoring for non-community systems will be between \$4.5 million and \$9.5 million. Between \$1.1 billion and \$1.8 billion will be required to build additional treatment facilities for removing contaminants from the nation's drinking waters. It will cost \$263 million per year for operation and maintenance of these required facilities. The annual per capita costs for those systems which will require treatment range from \$240 for a system serving 25 people and treating for heavy metal removal to under \$0.25 per year for systems serving over 100,000 people requiring disinfection. A constraint analysis examined the broad area of chemicals and supplies, manpower, laboratories, and engineering and construction services. (Humphreys-ISWS) W76-12821

#### ECONOMIC EVALUATION OF THE PROPOSED INTERIM PRIMARY DRINKING WATER REGULATIONS.

Energy Resources Co., Inc., Cambridge, Mass.  
J. E. Alpert.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 587, \$11.00 in paper copy, \$3.00 in microfiche. Report No. EPA-570/9-75-002, October 1975. 397 p, 12 fig, 140 tab, 72 ref. 11 append. EPA No. 68-01-2865.

Descriptors: \*Evaluation, \*Water treatment, \*Costs, \*Economics, Unit costs, Potable water, Monitoring, \*Regulation, Water costs, Water supply, Annual costs, Cost comparisons, Cost analysis, Municipal water, \*Water quality standards. Identifiers: \*Drinking water regulations.

An economic evaluation was performed of the Proposed Interim Primary Drinking Water Regulations as published in the March 14, 1975, Federal Register. The results of this study indicated the following: The annual costs for water monitoring for community system would be between \$22 and \$43 million, while the costs for water monitoring for non-community systems would be between \$47 million and \$92 million if the proposed regulations were adopted. A cost of between \$1.1 billion and \$1.8 billion would be required to build treatment facilities to remove contaminants from the nation's drinking waters. It would cost an additional \$282 million per year to operate and maintain the required treatment plants. The annual per capita costs for those systems which would require treatment would range from \$244 for a system serving 25 people and treating for heavy metal removal to \$0.25 per year for systems serving over 100,000 people requiring disinfection. A constraint analysis examined the broad areas of chemicals and supplies, manpower, laboratories, and engineering and construction services. (Humphreys-ISWS) W76-12822

#### URBAN RUNOFF POLLUTION CONTROL PROGRAM OVERVIEW: FY'76.

Municipal Environmental Research Lab., Edison, N. J. Storm and Combined Sewer Section.  
R. Field, A. N. Tafuri, and H. Masters.  
Report EPA-600/2-76-095, March, 1976. 67 p, 15 fig, 11 tab.



## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

Descriptors: \*Waste water treatment, \*Waste treatment, \*Sewage treatment, \*Runoff, \*Waste water (Pollution), Water pollution control, Sewage, Water quality, Hydrology, Combined sewers.

The basic technical and administrative problems associated with urban runoff and the approach of the Environmental Protection Agency's (EPA) research and development program to combat these problems are reviewed. Information on flood control, erosion control and the basic pollutional problems created by wet weather flows is presented. Nationwide cost requirements for abating urban runoff pollution and available abatement technology are discussed. Of overlying importance, program direction and desired goals are cited with intent towards a truer concept of solution methodology involving receiving stream impact analyses. Details of technologic advancements resulting from some 150 research and development projects are summarized. Both non-structural and structural control are included. The problem is divided into the categories of problem definition, user assistance tools, land management, collection system control, storage, treatment, sludge/solids, integrated systems, and technical assistance/technology transfer. General cost comparisons are made for urban runoff pollution control/treatment. A cost-effective solution for urban runoff pollution control by in-line storage in Seattle, Washington, and a simplified hypothetical plan for wet-weather flow pollution abatement for the Des Moines, Iowa, area are given. (Snyder-FIRL)

W76-12857

**APOLLO COUNTY PARK WASTEWATER RECLAMATION PROJECT. ANTELOPE VALLEY, CALIFORNIA.**  
Los Angeles County Engineer Dept., Los Angeles, Calif.  
For primary bibliographic entry see Field 5D.  
W76-12864

**TIOGA RIVER MINE DRAINAGE ABATEMENT PROJECT.**  
Pennsylvania Dept. of Environmental Resources, Harrisburg.  
A. F. Miorin, R. S. Klingensmith, and R. E. Heizer.  
Report EPA-600/2-76-106, June, 1976. 71 p, 18 fig, 15 tab, 3 ref.

Descriptors: \*Watersheds(Basins), \*Drainage, \*Mining, \*Coal mines, \*Strip mines, \*Mine drainage, Mine acids, Pollution abatement, \*Pennsylvania, Land reclamation.  
Identifiers: \*Tioga County(Penn), \*Surface mine reclamation.

A mine drainage abatement demonstration project for a mined area in the vicinity of Morris Run Village in Tioga County, Pennsylvania was determined to be feasible. The primary objective of the project is to demonstrate the effectiveness of various preventive measures in eliminating or reducing acid mine drainage discharges. The recommended project includes demonstrating effective techniques for mine drainage abatement, reducing a specific mine drainage problem, and restoring portions of a mined area to their approximate original surface grade. The project calls for the restoration of two strip mines; agricultural limestone will be used to establish vegetation in one and sewage sludge to establish vegetation in the other. The mine to be restored using sewage sludge covers 60 acres. Spoil piles will be used for fill. The site will be restored to its original grade, and holding or infiltration ditches will be constructed immediately downhill from the test plot. Three inches of sewage sludge will be placed on a 4.3-acre test plot and scarified into the top cover. The appropriate amount of grass seed will then be placed on the test plot. It is estimated that implementation of the project will result in a reduction of 8,480 lbs per day of acid under average ground-

water conditions. Significant reductions in high flows and loadings are expected from mine drainage discharges during and immediately after precipitation. It is estimated that preventing the runoff from a one-inch 24-hour rainfall from entering the interconnected deep mines will result in a reduction of 63,200 lbs of acid. These reductions should cause an improvement in river water quality. (Snyder-FIRL)

W76-12874

**HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS - EVALUATION OF KINETIC COEFFICIENTS.**  
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.  
For primary bibliographic entry see Field 5D.  
W76-12903

**EXAMPLE FOR REGIONAL PLANNING OF WATER QUALITY IN DENMARK (BEISPIEL EINER REGIONALEN PLANUNG DER GEWÄSSERQUALITÄT IN DÄNEMARK).**  
G. Posselt.  
Forum Umwelt Hygiene, Vol. 27, No. 5, p 160-164, 1976. 1 fig, 2 tab, 6 ref.

Descriptors: \*Planning, \*Water quality, Europe, Streams, \*Watersheds(Basins), Sewerage, Human population, Water demand, Evaluation, Costs, \*Regional analysis, Regions.  
Identifiers: \*Saprobic levels, \*Denmark.

A simple scheme for water quality planning in a given region of Denmark uses the classes of the saprobic system. An analysis of the fundamental physical factors for water quality in nearby areas at streams of the region's drainage basins is the plan's basis. This analysis determines the best possible saprobic level after eliminating all known sewage discharges in the area. The next step is a statement of human demands regarding activities at or near watercourses. Dialogue with local associations, municipal organizations, and others interested in sufficient water supplies is necessary. The temporary water quality goal can be defined by comparison of the basic saprobic level, expressing the physical influence of the surroundings, with that level of saprobicity which is assumed to assure the various needs of the population. The necessary measures are then drafted. The plan's feasibility is then determined by evaluating the probable costs. (Snyder-FIRL)

W76-12918

**ADMINISTRATION - SYSTEMS ANALYSIS, (LITERATURE REVIEW).**  
Cornell Univ., Ithaca, N. Y. Dept. of Environmental Engineering.  
D. P. Loucks, and J. M. Bell.  
Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1639-1648, June, 1976. 72 ref.

Descriptors: \*Water management(Applied), \*Planning, \*Administration, \*Water quality, Land use, Waste water treatment, Waste water disposal, Model studies, Sewers, Simulation analysis, Treatment facilities, Water reuse, Optimization, Economics, Monitoring, Sampling, Data collections, Reviews, \*Bibliographies.  
Identifiers: \*Literature reviews.

A literature review of the administration of water quality planning and analysis is presented. General topics covered include: comprehensive planning and reviews, land use effects and management, sewer design, waste water treatment systems, waste water disposal on land, waste water reuse, water quality modeling, thermal pollution, monitoring and sampling, and data management. Specific subjects discussed under the above general headings include: methodology for integrating water quantity and water quality management, a method for forecasting the pollution

resulting from urban growth, control strategy for minimizing water pollution in receiving water caused by overflows in combined sewer systems, a dynamic programming model for planning the future expansion and operation of a waste water treatment plant, the development of a soil loss, land-water allocation optimization model, simulation studies of the reuse of municipal waste water for water supply augmentation, modeling studies of the effects of variable waste generation and streamflows on water quality, evaluations of deep reservoir models for temperature prediction in lakes, system behavior and cost models for effluent sampling programs, and methods for generating information needed for the design of cost effective water quality control programs. (Kreager-FIRL)

W76-12926

**ODOR CONTROL WITH HYDROGEN PEROXIDE.**  
IDP, Pennsylvania State Univ., Middletown. Dept. of Engineering.  
For primary bibliographic entry see Field 5D.  
W76-12932

**ESTIMATES OF SOCIO-ECONOMIC DAMAGES OF AN OIL SPILL.**  
Institute for Water and Air Pollution Research, Stockholm (Sweden).  
I. Rosenblum, and A. Jernelov.  
IVL (Institutet för Vatten- och Luftvårdsforskning) Publication No. B 264, December 1975. 23 p. 5 tab., 3 ref.

Descriptors: \*Oil spills, \*Social impact, \*Economic impact, Damages, Fisheries, Oil pollution.  
Identifiers: Guatemala, \*Caribbean Sea, Livingston(Guatemala).

The impact of an oil spill in the Caribbean Sea off the Guatemala coast on April 1975 was evaluated as to the probable duration of its effects and an assessment of the economic losses involved. The residents of the town of Livingston and along the coast up to the border of Belize at Sarstun River, British Honduras, were interviewed to determine the importance of the fishery to the local population; the extent and type of damage, and its economic and social implications. The inventory of damages included direct damages in financial losses borne by the fishermen due to disruption of their fishing activities, reduced catch, equipment damages. Indirect damages were cost due to lost fish consumption of the fishermen and their dependents; and lost income of the petty fish trade. An additional decrease in the catch, although temporary, may result in an accelerating abandonment of fishing which may cause further impoverishment, increased migration to already overpopulated urban areas offering little employment; and a further disruption of the society. The bulk of the damage constituted financial losses to 43% of the population in the communities due to the interruption of the fishing activities for an average of 15 days and reduced catch for 75 days after the oil spill occurred. (Auen-Wisconsin).

W76-12947

**DOES WATER USE RESTRICT THE LOCATION OF INDUSTRIAL AIR POLLUTERS.**  
Argonne National Lab., Ill.  
D. Santini.  
Water, Air, and Soil Pollution, Vol. 5, No. 2, p 185-194, 1975. 1 fig., 5 tab., 6 ref. NSF(RANN) AG 352 and GI 32989 A2.

Descriptors: \*City planning, \*Water utilization, \*Sites, \*Industries, \*Air pollution, Pollution abatement, Illinois, Labor supply, Water supply.  
Identifiers: Industrial clustering.

Water use in industrial production is responsible for much of the urban clustering and consequent

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

air pollution. An added impetus toward urban industrial concentration is the availability of a labor supply. In Illinois most particulate and sulfur oxide emissions are generated by industries which use more than 5 billion liters of water per establishment per year, thus most industrial air pollutants are emitted in urban areas which are on water bodies that supply large consistent water volumes. The effectiveness of policies promoting geographic dispersal to solve air pollution problems will be limited by an adequate water supply and the tendency of major employing, water-using, air polluting industries to choose urban sites. Such policies will only be effective if adequate water supplies are provided at alternative locations or that water use is eliminated from the production process. In themselves these conditions do not insure success. Raw material location, water quality, water for transportation, and input-output relationships between industries also influence clustering. The conjunction of air pollution with industrial water use indicates that much closer attention should be given to the relation between air and water pollution with some study of the possibility of substitution of one form of pollution for another. (Buchanan-Davidson-Wisconsin). W76-12950

**CONSERVATION: EESG BIBLIOGRAPHY SERIES:16.**  
Reading Univ. (England). Dept. of Economics.  
For primary bibliographic entry see Field 6B.  
W76-12953

**WATER POLLUTION, EESG BIBLIOGRAPHY SERIES:17.**  
Newcastle-upon-Tyne (England). Center for Research in Public and Industrial Economics.  
D. J. Storey, and P. McCabe.  
EESG (Environmental Economics Study Group) Bibliography Series 17, February 1975. 14 p. 150 ref.

**Descriptors:** \*Management, \*Economics, \*Pollution abatement, \*Bibliographies, \*Industrial wastes, Costs, Pollution taxes (Charges), Pricing, Water pollution control, Environment, Water resources development, Water quality control, Sewage treatment, Cost-benefit analysis, Welfare (Economics), Permits.  
**Identifiers:** \*Public policy.

The economic aspects of environmental and water pollution and their control are presented in 150 references. The scope of the subjects ranges from guidelines for devising an approach methodology for environmental and water pollution control, the efficacy of bribes and charges, the efficacy of quality standards, and environmental protection as related to international spillovers and trade. Other citations relate to the efficiency of public enterprises in developing natural resources, capital and operating costs of sewage treatment, water supply and demand, water and waste management, effects of water pollution, and the economic impact of pollution on industries and economic incentives for water quality improvement. Other discussions center on public environmental policy, management, techniques and costs thereof, legal aspects, economic welfare, a multi-level approach to modeling and control of water pollution, marginal cost pricing, effluent and sewer charges, permits, and water pollution control cost functions. (Auen-Wisconsin) W76-12963

**WISCONSIN ANNUAL REPORT 1975,**  
Upper Great Lakes Regional Commission, Madison, Wis.  
For primary bibliographic entry see Field 6B.  
W76-12964

**LOSSES OF NITROGEN IN SURFACE RUNOFF IN THE BLACKLAND PRAIRIE OF TEXAS,**  
Texas Agricultural Experiment Station, College Station.  
D. E. Kissel, C. W. Richardson, and E. Burnett.  
Journal of Environmental Quality, Vol. 5, No. 3, p. 288-293, July-September 1976. 1 fig, 4 tab, 16 ref.

**Descriptors:** Nitrogen, Nitrates, \*Nutrient removal, Texas, \*Surface runoff, \*Nitrogen compounds, Agricultural watersheds, Fertilizers, Nitrites, Leaching, Water pollution sources, Water quality, Agricultural runoff, Soil erosion, Water pollution, Nutrients, Organic matter, Runoff, Analytical techniques, Watersheds (Basins), Grain sorghum, Cotton, Oats.  
**Identifiers:** \*Nitrogen losses, \*Texas Blackland Prairie, \*Fertilizer losses, \*Nitrate losses, \*Houston Black clay, Analytical procedures, Total nitrogen, Nitrate-N.

The objective was to determine NO<sub>3</sub>-N and total N losses in surface runoff from Houston Black clay, a swelling clay soil with a relatively low infiltration rate. The study was carried out on duplicate 4-ha watersheds cropped to a rotation of grain sorghum, cotton, and oats, all fertilized at recommended rates of N application. The loss of NO<sub>3</sub>-N varied considerably during the study, depending on events before each runoff-producing storm. Concentrations on NO<sub>3</sub>-N were usually highest just after fertilizer application when the soil was near field capacity and lowest when large amounts of water infiltrated into dry soil immediately before runoff. During runoff-producing storms just after fertilizer application, the concentrations were lowest in the initial runoff and highest near the end of the runoff event. To compute NO<sub>3</sub>-N losses with reasonable accuracy on these soils, the shape of the entire NO<sub>3</sub>-N concentration curve needed to be well defined. In general, the results of this study indicated that a small and probably insignificant amount of N is lost to surface waters when crops are fertilized at recommended N rates in the Texas Blackland Prairie. For the entire 5-year study, the mean concentration of NO<sub>3</sub>-N in runoff was 2.9 and 2.3 ppm NO<sub>3</sub>-N for the duplicate watersheds. The mean total loss of NO<sub>3</sub>-N was 3.2 kg/ha/year. Losses of sediment-associated N were about 5 kg N/ha/year. (Henley-ISWS) W76-12982

**SAMPLERS FOR MONITORING RUNOFF WATERS,**  
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5A.  
W76-13006

**VARIATION OF SUSPENDED SEDIMENT LOAD IN THE PALOUSE REGION OF THE NORTHWEST,**  
D. K. McCool, and R. I. Papendick.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-19, 1975, Chicago, Illinois. 20 p, 4 fig, 9 tab, 11 ref. ASAE Paper 75-2510.

**Descriptors:** \*Suspended load, \*Suspended solids, \*Sediment yield, \*Sediment load, \*Sampling, Water quality, Return flow, Water quality control, Water pollution, Pacific Northwest US, Washington, Idaho, Oregon.  
**Identifiers:** \*Palouse River basin area (Wash-Ida-Ore).

Sediment concentrations in the Palouse small-grain dryland region of the Northwest are extremely variable on a daily, seasonal, and annual basis. Runoff events of from one to a few days in length can account for large percentages of the annual sediment discharge, and the sediment transport of a given year can be as large as the total of 4 or 5 other years. Sampling programs based on weekly samples, even at stations with excellent

streamflow records, can give extremely misleading results. Sampling programs of 1 or 2 years' duration can also give extremely misleading results. If money and personnel constraints dictate a low-frequency short-duration sampling program, then it is essential that some typical portion of the study area be monitored with a high-frequency longer-duration sampling program to assess the results and for adjustment purposes. (Skogerboe - Colorado State) W76-13012

**MEETING FUTURE WATER REQUIREMENTS BY WATER CONSERVATION,**  
Soil Conservation Service, Golden, Colo.  
For primary bibliographic entry see Field 3F.  
W76-13013

**FACTORS INFLUENCING THE LOSS OF NITROGEN AND PHOSPHORUS FROM A TRACT OF IRRIGATED LAND,**  
Idaho Univ., Moscow. Dept. of Agricultural Engineering.

J. R. Busch, D. W. Fitzsimmons, G. C. Lewis, D. V. Naylor, and K. H. Yoo.  
Presented at the 1975 Winter Meeting of the American Society of Agricultural Engineers, December 15-18, 1975, Chicago, Illinois. 11 p, 2 fig, 4 tab, 11 ref. ASAE Paper 75-2543.

**Descriptors:** \*Nitrogen, \*Phosphorus, \*Irrigation effects, Surface irrigation, Irrigation, Irrigation practices, Leaching, Nutrients, Return flow, Water pollution, \*Regression analysis.

A study was conducted to identify factors that influence the loss of nitrogen and phosphorus from a tract of irrigated land. A multiple regression analysis was used to determine the influences of nine identifiable factors. The statistics of the analytical relationships obtained indicate that they are suitable for estimating the amounts of nutrients lost in surface runoff from the studied tract. The amounts of chemical constituents lost in surface runoff from a gravity irrigated farm are dependent upon several independent variables including total solids lost, amounts of nutrients applied, and water retained on the field. Specific conclusions are: (1) the amounts of nutrients in the surface runoff were significantly affected by the amounts of total solids and water lost in surface runoff, and the amounts of nutrients applied in headwaters. (2) More soluble and total phosphorus and ammonia nitrogen were lost to surface runoff in earlier irrigations than in later irrigations. (3) Increasing the percentage of applied water retained on a field and reducing the amounts of fertilizer added to irrigation water would decrease the amounts of all nitrogen forms lost in surface runoff. All results presented are applicable to the study site monitored. However, the relationships developed and conclusions drawn may be applied with caution to similar areas managed with similar cultural practices. (Skogerboe - Colorado State) W76-13014

**ESTABLISHING WATER, NUTRIENT AND TOTAL SOLIDS MASS BUDGETS FOR A GRAVITY-IRRIGATED FARM,**  
Idaho Univ., Moscow. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W76-13015

**IRRIGATION REUSE SYSTEMS—A PROPOSED NEW ASAE ENGINEERING PRACTICE,**  
Colorado State Univ., Fort Collins. Dept. of Agricultural.  
For primary bibliographic entry see Field 3C.  
W76-13016

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

#### WHAT DO WE DO ABOUT THE WATER POLLUTION CONTROL ACT.

Watson and Co., Tampa, Fla. Environmental Services Div.  
V. D. Patton.  
Public Works, Vol 107, No 9, p 78-81, September, 1976.

Descriptors: \*Water quality act, \*Legislation, \*Federal Water Pollution Control Act, \*Water quality standards, Water pollution control, Pollution abatement.

Identifiers: \*Federal Water Pollution Control Act Amendments, Legislation implementation.

The 1972 Federal Water Pollution Control Act Amendments, PL 92-500 are being reviewed in depth by many groups and individuals. This review has resulted in criticism of the constructive nature. This article is an example of the criticism offered. PL 92-500 is the most sweeping piece of legislation on water pollution control ever conceived. It is idealistic, assuming automatic compliance with unrealistic goals and deadlines by offenders and over-estimating the ability of the public to become sufficiently informed to make competent decisions by mass participation. There were no realistic estimates of the funding required to meet the greatly expanded definition of treatment works contained in the Act. An original concept fostered by some was that area wide waste management meant one treatment plant for a region covering perhaps several counties - this may require abandonment of existing plants still carrying bonded indebtedness. The provision for zero discharge is in some cases possible while forever impossible in others. Lack of uniformity in goals and lack of communications within some agencies is a real problem. Consultant selection has been complicated by recent legislative and administrative actions such as Florida's Consultant Competitive Negotiation Act. What is needed is: (1) A set of performance criteria to be established for state water pollution agencies in the area of implementation; (2) An improvement of communications between agencies and parts of agencies; (3) Maintaining the same priorities; (4) Realistic planning; (5) Less paperwork; and (6) Use of trained professionals. (Heiss-NWWA)  
W76-13037

#### ENERGY DEVELOPMENT: THE ENVIRONMENTAL TRADEOFFS. VOLUME 3: RELATIVE ENVIRONMENTAL RANKING OF PROPOSED OFFSHORE CONTINENTAL SHELF AREAS ON THE BASIS OF IMPACTS OF OIL SPILLS.

Stanford Research Inst., Menlo Park, Calif.  
For primary bibliographic entry see Field 6G.  
W76-13039

#### A PROPOSED METHODOLOGY FOR ASSESSING ALTERNATIVE TECHNOLOGIES.

Cornell Univ., Ithaca, N. Y. Program on Science, Technology and Society.

For primary bibliographic entry see Field 6G.

W76-13049

#### PUBLIC EVALUATION OF WATER QUALITY AND ITS IMPACT ON RECREATION: A CASE FROM IOWA.

Waterloo Univ., (Ontario). Dept. of Geography.  
J. S. Gardner, and P. Frankland.  
Institute of Urban and Regional Research, University of Iowa, Iowa City. Technical Report No. 38, December 1974. 17 p, 1 fig, 6 tab, 26 ref.

Descriptors: \*Water pollution effects, \*Water quality standards, \*Water quality, \*Recreation, \*Evaluation, Aesthetics, Turbidity, Quality control, Public health, Reservoirs, Nutrients, Sediments, Social participation, Coliforms, \*Iowa.

Identifiers: \*Iowa River(IA), \*Coralville Reservoir(IA), \*Public participation.

The Iowa River and Coralville Reservoir, a multi-purpose flood control project where recreation has become a major function of the project, were studied to determine the impact of water quality on the degree of participation in and enjoyment of water-based recreation. River valleys providing natural forest cover for wildlife and sites for artificial lakes are the recreational focal points in Iowa. Recent surveys indicate that at least 80% of users of the area do so because of water-based recreational opportunities. Primary purpose of the study was to find how public evaluation of water quality differed from scientific standards of water quality. Scientific standards required accepted levels of pathogenic organisms (especially fecal coliform), toxic or skin-irritating substances, and objectionable odors or floating material. However, subjective evaluations used as criteria: trash and junk, muddy water, smell, scum, foam, taste, rough fish and dead fish. Subjective evaluations of water quality discouraged participation despite water being declared safe for recreational purposes according to state standards. Fifty-seven percent of the river basin sample refused to let their children swim in river water because of its poor quality. It was found that subjective evaluation of poor water quality did not dampen enjoyment of those who do participate. (Gentry-NC)  
W76-13050

#### ANNUAL REPORT FOR THE YEAR ENDING MARCH 31, 1975, SASKATCHEWAN DEPARTMENT OF THE ENVIRONMENT.

Saskatchewan Dept. of the Environment, Regina.  
For primary bibliographic entry see Field 6E.

W76-13052

#### DEVELOPMENT OF RESIDUALS MANAGEMENT STRATEGIES: AN EXECUTIVE SUMMARY.

Indiana Univ., Bloomington. School of Public and Environmental Affairs.  
R. S. Howe, and N. L. White.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 011. Environmental Protection Agency, Report EPA-600/1-76-01/A, Socioeconomic Environmental Studies Series, Water Quality Guidance. 28 p, 5 fig, 3 tab. EPA-R-803313-01-1.

Descriptors: \*Decision-making, \*Management, \*Cost allocation, \*Cost sharing, \*Planning, \*Evaluation, Institutions, Model studies, Project planning.

Identifiers: \*Residuals management, \*Residuals discharge, \*Environmental quality.

A residuals generation and discharge model is proposed which has the advantages of identifying different methods to achieve environmental standards, identifying and evaluating residuals management strategies (RMS), identifying at different points of residual generation and discharge when intervention with physical measures can take place. The study is designed to identify and describe means for achieving environmental quality in a fair and cost effective way, and to help decision makers find and implement residuals management programs. The planning process should determine goals and objectives, including identifying and selecting strategies for achieving goals. Such decisions require consideration of (1) factors influencing plans for the environment: the level of environmental quality desired, costs to achieve that level of quality, who pays the cost, benefits, strategies to achieve the goal, and (2) constraints on environmental management: economic, legal, political, technical, social. In selecting a strategy, a RMS combines 3 components - physical methods, implementation of physical methods, and institutional arrangements supporting implementation measures. To develop and evaluate a RMS it is necessary to (1) define the problem; (2) specify all physical methods; (3) analyze alternative physical methods; (4) identify implementation measures and institutional ar-

rangements; (5) formulate alternative RMSs; (6) evaluate alternative RMSs; and (7) choose strategy for implementation. (Gentry-North Carolina)  
W76-13054

#### OPERATION AND IMPACT OF NPDES IN REGION II, PART 2.

Environmental Protection Agency, New York, Caribbean Construction Grants Branch.  
W. J. Muszynski, and T. J. Olenik.  
Water and Sewage Works, Vol. 123, No. 6, p 93-95, June, 1976. 2 tab, 10 ref.

Descriptors: \*Permits, \*Regulation, \*Industrial wastes, Pollutants, Economics, Monitoring, Effluents, New York, New Jersey, Puerto Rico, Virgin Islands, Programs, Cost analysis, Biochemical oxygen demand, Suspended solids, Waste water treatment, Equipment, \*Economic impact, \*Water quality standards.

Identifiers: \*National Pollutant Discharge Elimination System.

The National Pollutant Discharge Elimination System is discussed in terms of the permit program's operation and its physical and economic impact on municipal dischargers in the Region II area which includes New York, New Jersey, Puerto Rico, and the Virgin Islands. The monitoring, testing, and reporting requirements of the permit program are generally much more stringent than previous requirements under state programs. Most permits require weekly 24-hour composite sampling of biochemical oxygen demand and suspended solids. Case histories of the economic impacts of the permit program are reviewed for the upgrading of existing facilities, industrial waste monitoring, and the installation of flow, monitoring, and chlorination equipment. A detailed cost analysis is presented for each case reviewed. (See also W76-10005) (Kreager-FIRL)  
W76-13059

#### A BRIEF HISTORY OF SEWAGE TREATMENT - 2 THE ROYAL COMMISSION.

J. M. Sidwick.  
Effluent and Water Treatment Journal, Vol. 16, No. 4, p 193-195, 197-199, April, 1976.

Descriptors: \*Organizations, \*History, \*Sewage treatment, \*Industrial wastes, Waste water treatment, Estuaries, Sewers, Standards, \*Water quality standards.

An historical review of the establishment and activities of the Royal Commission on Sewage Disposal is presented. The Commission was appointed on May 7, 1898 to investigate methods of treating and disposing of sewage. Activities of the Commission included: the identification of artificial treatment processes, an evaluation of problems associated with the discharge of trade wastes into municipal sewers, studies of the operational characteristics of various sewage treatment methods, the investigation of problems associated with the disposal of distillery wastes and the nuisances caused by seaweed in sewage polluted estuaries, recommendations for standards to which sewage works effluent should conform, and studies on methods for treating industrial wastes not discharged to municipal sewers. (Kreager-FIRL)  
W76-13060

#### ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA, VOLUME I.

Resource Planning Associates, Inc., Cambridge, Mass.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 895, \$6.00 in paper copy, \$3.00 in microfiche. Report Reference No. RA-75-28 prepared for U.S. Environmental Protection Agency, November 1975. 142 p, 3 append.



**Descriptors:** \*Continental Shelf, \*Alaska, \*Environmental effects, \*Water quality, \*Oil pollution, \*Air pollution, \*Water pollution, \*Resources development, Economics, Gases.  
**Identifiers:** \*Outer Continental Shelf, Environmental impact.

The potential secondary impacts, both economic and environmental, on Alaska resulting from OCS as well as on onshore oil and gas development will be substantial. These impacts will be felt on a local basis in varying degrees of severity. The quantification of these local area results is contained in great detail in an appendix. Some localities, such as Anchorage and Fairbanks, will receive impacts from nearly every development possibility, while others, such as Nome, Valdez, and Yakutat, will experience impacts from only a few conditions. (See also W76-13091) (Sinha-OEIS)  
 W76-13090

#### ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA. VOLUME II. METHODOLOGY APPENDICES.

Resource Planning Associates, Cambridge, Mass. Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 896, \$6.75 in paper copy, \$3.00 in microfiche. Report Reference No. RA-75-28, prepared for U.S. Environmental Protection Agency, November 1975. 158 p, 3 append. 68-01-2465.

**Descriptors:** \*Continental Shelf, \*Alaska, \*Oil pollution, \*Resources development, \*Environmental effects, \*Air pollution, \*Water pollution, \*Land use, Methodology, Water resources, Economics.  
**Identifiers:** \*Outer Continental Shelf, Environmental impact.

The first step in the methodology is an analysis of the essential components of a general model of oil and gas development. Each of these components is then defined. The next step is to make a series of assumptions that are essentially a set of parameters of the components. Next an appropriate set of assumptions is selected that map the model onto each individual area of the study to yield a development alternative. Finally, the development alternatives are ranked cumulatively. (See also W76-13090) (Sinha-OEIS)  
 W76-13091

#### A WATER-QUALITY SIMULATION MODEL FOR WELL MIXED ESTUARIES AND COASTAL SEAS: VOLUME VIII, AN ENGINEERING ASSESSMENT.

Rand Corp., Santa Monica, Calif.  
 For primary bibliographic entry see Field 2L.  
 W76-13093

#### SHIPBOARD OIL-IN-WATER CONTENT MONITOR BASED ON SMALL ANGLE FORWARD LIGHT SCATTERING.

General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.  
 E. Batutis, and F. Caelelo, Jr.  
 Available from the National Technical Information Service, Springfield, VA 22161 as ADA-022 895, \$7.50 in paper copy, \$3.00 in microfiche. U. S. Coast Guard Final Report No. USCG-D-35-76, December 1975. 183 p, 59 fig, 46 tab. DOT-CG-32, 370-A.

**Descriptors:** \*Oil spills, \*Monitoring, \*Oil pollution, Detergents, Particle size, Performance, Testing procedures, Measurement, Continental Shelf, Instrumentation, Equipment, \*Pollutant identification.  
**Identifiers:** \*Outer Continental Shelf, Optical scattering, Bunker oil, Particulate matter.

Further development of an on line Oil-in-Water Content Monitor is presented. The basic technique of optical scattering monitoring has been main-

tained. Performance verification in various test situations was conducted. Interferences such as particulate matter, gravity, pH of water, salinity of water, and temperature of water were investigated; the only serious interference being small particulate matter. Effects of oil droplet size, detergents and type of oil on monitor performance were also investigated. At its present level of development the monitor will produce errors of less than + 10% within a single oil type at 125 ppm level. At the same level, errors less than + 14% can be expected from oil mixtures without Bunker C. Oil mixtures including Bunker C produced an error band of + 33%. (Sinha-OEIS)  
 W76-13094

**PROFESSIONAL BIAS AND WATER REUSE,**  
 George Williams Coll., Downers Grove, Ill.  
 J. H. Sims, and D. D. Baumann.  
 Economic Geography, Vol 52, No 1, p 1-10, 1976. 1 fig, 5 tab, 8 ref.

**Descriptors:** \*Decision making, \*Professional personnel, \*Water reuse, \*Attitudes, Psychological aspects, Potable water, Waste water treatment, Recycling.  
**Identifiers:** Consulting engineers, Health officers.

The attitudes, feelings, and expectations of consulting engineers and public health officials toward public use of renovated wastewater were evaluated by showing them a picture of seven men attending a mayoral conference to discuss the possibility of coping with an impending water shortage by using reclaimed wastewater. They were asked to tell a story describing who the men were; what was happening; what the men were thinking, feeling, and saying; and how they thought the situation would turn out. The results revealed orientations based on their initial attitudes toward such a proposal, perceptions of problems which might be encountered, personal concerns, and professional position. Health officials were more negative: they resisted the idea, raised many major objections, and their reflection strengthened their antagonism. Consulting engineers had a more favorable attitude at first, raised fewer objections, and were divided between endorsement or rejection. This projective technique showed the nature and strength of professional support and resistance to water reuse. The responses reflected professional expertise and bias. The psychological bias inherent in professional experts and the full range of its implications in the formulation and implementation of public policy on environmental issues needs to be identified. (Buchanan-Davidson-Wisconsin)  
 W76-13096

#### THE BUDDING ENVIRONMENTAL CLEAN-UP (A VIEWPOINT): PART II. CLEAN UP, COSTS AND GROWTH.

Northeastern Illinois Univ., Chicago. Dept. of Earth Sciences.  
 R. H. Charlier, and M. Vigneaux.  
 International Journal of Environmental Studies, Vol 8, No 1, p 121-136, 1975. 71 ref.

**Descriptors:** \*Attitudes, \*Industrial production, \*Pollution abatement, \*Environmental sanitation, Foreign countries, United States, Waste disposal, Water pollution, Air pollution, Legislation, Costs, Penalties(Legal), Oceans, Economics.  
**Identifiers:** \*Environmental protection, \*Economic growth.

There is world-wide concern about environmental deterioration. Earth Day 1970 aroused public interest in some of the major areas of concern and stimulated some excellent programs, but lacked impetus. Some of the environmental protection efforts which have been started in the United States, France, and other countries are described. Water and air pollution are very acute problems in many parts of the world, but corrective actions have been piecemeal, sporadic, and uncoordinated. A national and international policy which would con-

serve and protect our natural resources is needed. Legislation is a step in the right direction, but too often enforcement is lacking. Developments to prevent pollution by petroleum products are described. Various methods have also been developed to handle garbage. At a meeting of representatives from 91 nations, a list of substances which should not be dumped into the ocean was developed, but the group lacks the force of law. Also there is the conflict between environmental protection and economic growth. (Buchanan-Davidson-Wisconsin)  
 W76-13098

**SEAFOOD PROCESSING IN RELATION TO COASTAL INDUSTRIAL PARK CONCEPTS,**  
 North Carolina State Univ., Raleigh. Dept. of Food Science.  
 For primary bibliographic entry see Field 6B.  
 W76-13101

**APPARATUS AND METHOD FOR PROTECTING A SHORELINE AGAINST CONTAMINATION FROM AN OIL SPILL,**  
 RRC International, Inc., Latham, N.Y. (Assignee). M. Goldman.

U.S. Patent No. 3,962,083, 4 p, 9 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 755, June 8, 1976.

**Descriptors:** \*Patents, \*Oil spills, \*Oil pollution, Coasts, Beaches, Shores, Water pollution, Absorption, Plastics, Mechanical equipment.  
**Identifiers:** Amphibious vehicles, Oil-absorbing web.

A method and apparatus is described to protect the shoreline from contamination due to the deposit of oil from an oil spill on adjacent waters. A protective oil-absorbing blanket or web is laid on the shoreline, preferably in anticipation of the arrival of an oil spill. The web-laying vehicle includes a body which is watertight and which is mounted on six wheels having relatively soft tires. This all-terrain vehicle which is amphibious has a suitable frame for supporting a coiled web and for guiding the web onto the shoreline as the vehicle moves along. The vehicle also has the means for loading the web back onto it and means for extracting the oil. The web may be fabricated from two layers of cellulose fibers supported on an intermediate scrim or a heavy molded plastic netting confining shredded polyolifins. (Sinha-OEIS)  
 W76-13144

#### RETRIEVAL MEANS FOR A FLOATING LIQUID SPILLING.

W. P. Kirk, and D. W. Reynolds.  
 U. S. Patent No. 3,963,617, 4 p, 6 fig, 5 ref; Official Gazette of the United States Patent Office, Vol 947, No 3, p 1264, June 15, 1976.

**Descriptors:** \*Patents, \*Oil spills, \*Oil pollution, \*Water pollution control, Water pollution, Pollution abatement.  
**Identifiers:** Oil slicks.

An apparatus for recovering floating liquids is comprised of a sheet with a weighted periphery. The sheet is deployed by use of explosives which spreads the sheet horizontally over the liquid surface, after which the periphery submerges, confining and centrally concentrating the floating oil. In addition to the weights, the flexible sheet is provided with flotation and vent means to provide buoyancy and to facilitate the venting of air entrapped between the sheet and the spill during deployment. A line is secured to the weights at the edge of the sheet and passes through a loop on the opposite edge which tends to pull the edges of the sheet together thereby assisting in collapsing the structure. The line is also provided with an additional length to form a tow line. (Sinha-OEIS)  
 W76-13152

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

#### METHOD OF REMOVING MATERIAL FROM A BED OF A BODY OF WATER,

T. A. Mathieu.  
U. S. Patent No. 3,964,184, 4 p, 4 fig, 9 ref; Official Gazette of the United States Patent Office, Vol 947, No 4, p 1458, June 22, 1976.

Descriptors: \*Patents, \*Water pollution, \*Water quality control, Bodies of water, Water pollution sources, Mine wastes, Hydraulic equipment, Turbulence, Fluid mechanics, Dredging.  
Identifiers: Barite, \*Mud pits.

A method is provided for removing material, such as cuttings and barite from bodies of water such as so-called mud pits which are simply ponds, lakes or like bodies of water whose beds are covered by the material which is to be removed. However, since the material is rather dense due to having settled to the bottom, the method includes utilization of a floating hull such as a platform from which water is drawn from the body of water close to its upper surface. The drawn water is formed into generally parallel pressurized streams inclined to the horizontal and directed rearward from the stern of the hull and released at points substantially removed from and generally equidistant from the hull and adjacent to the material for creating a turbulence and admixing the material and water. Then the material-water admixture is collectively withdrawn and disposed of. The water is picked up relatively particle free during initial operation of the barge. The primary key to achieving the turbulence or jetting action is the fluid velocity and not pressure. The more gallons pumped through the jets, the quicker the particles will combine with the water to form the material-water (slurry) admixture. (Sinha-OEIS)  
W76-13155

#### METHOD AND APPARATUS FOR PRECIPITATING COLLOIDS FROM AQUEOUS SUSPENSIONS,

Canton Textile Mills, Inc., Ga. (Assignee).  
For primary bibliographic entry see Field 5D.  
W76-13159

#### DESCRIBING VARIANCE WITH A SIMPLE WATER QUALITY MODEL AND HYPOTHETICAL SAMPLING PROGRAMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W76-13162

#### DESIGNING REGIONALIZED WASTE WATER TREATMENT SYSTEMS,

Ohio State Univ., Columbus. Department of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-13166

#### OPTIMAL ESTIMATION OF DO, BOD, AND STREAM PARAMETERS USING A DYNAMIC DISCRETE TIME MODEL,

Purdue Univ., Lafayette, Ind. School of Electrical Engineering.  
For primary bibliographic entry see Field 5A.  
W76-13167

#### DEVELOPMENT AND APPLICATION OF A WATER RESOURCE ALLOCATION MODEL,

Engineering-Science, Inc., Berkeley, Calif.  
W. O. Maddaus, and J. M. McGill.  
Water Resources Research, Vol. 12, No. 4, p 767-774, August 1976. 3 fig, 8 ref.

Descriptors: \*Water resources development, \*Water allocation(Policy), \*Water supply, \*Water quality control, \*Alternative planning, \*Waste water(Pollution), \*Management, Water demand, Constraints, Water policy, \*Groundwater, Environment, Reservoirs, Arizona, Regions, Digital

computers, Mathematical models, Optimization, Systems analysis.  
Identifiers: Cost minimization, Cost effective, \*Tucson(Arizona).

A water resource optimization model is described for use in long-range infrastructure planning for water supply and waste water management. The model includes a network analyzer to determine least-cost allocation of available sources of water supply (including reclaimed waste water) to various demand points subject to certain physical constraints and water management policies, a recosting procedure for nonlinear cost functions, a digital groundwater model for simulating widespread changes in groundwater depth, and a salt balance model for simulating groundwater quality changes with time. The modeling system provides costs for the optimal water resource allocation for various sets of constraints as well as the environmental changes in the groundwater reservoir, as represented by the number of years until groundwater levels fall to 76 m below 1970 levels and quality of the supply. The most cost-effective alternative has been identified and used to develop a 50-year water supply and waste water management plan for the Tucson Arizona regional area. The least-cost alternative is identified as the serving of all projected water needs from groundwater sources and augmenting the groundwater in the northern portion of the study area by recharging with reclaimed water along the Rillito River. (Bell-Cornell)  
W76-13168

#### REMOVAL OF TRACE ELEMENTS BY THE DNESTR RIVER, (IN RUSSIAN),

Y. V. Bumba.  
Izv Akad Nauk Mold SSR Ser Biol Khim Nauk. 4, p 59-62, 1973.

Descriptors: \*Trace elements, Rivers, Absorptions, Aquatic animals, Manganese, Zinc, Copper, Cobalt, Iodine.  
Identifiers: Dnestr River(USSR).

The results of a 2-yr study of the content and removal of trace elements by the Dnestr River (USSR) are presented. In the Dnestr the content of such biologically active and vitally necessary elements as I and Co is 3-4 times less than the less active elements Cu, Zn and Mn. The levels of trace elements in the river and their removal can be arranged in the descending order Mn-Zn-Cu-Co-I. The minimum level of trace elements and their removal by the river occurred in July. This is attributed to their increased utilization by aquatic organisms and absorption by suspended organic and mineral particles and mud.—Copyright 1975, Biological Abstracts, Inc.  
W76-13197

## 6. WATER RESOURCES PLANNING

### 6A. Techniques Of Planning

#### ADMINISTRATION - SYSTEMS ANALYSIS, (LITERATURE REVIEW),

Cornell Univ., Ithaca, N. Y. Dept. of Environmental Engineering.  
For primary bibliographic entry see Field 5G.  
W76-12926

#### METHODOLOGY FOR THE SELECTION AND APPLICATION OF PROBABILITY MODELS FOR THE SIMULATION OF DAILY RAINFALL AND RUNOFF,

Purdue Univ., West Lafayette, Ind. School of Civil Engineering.  
For primary bibliographic entry see Field 7A.  
W76-12994

A PROPOSED METHODOLOGY FOR ASSESSING ALTERNATIVE TECHNOLOGIES,  
Cornell Univ., Ithaca, N. Y. Program on Science, Technology and Society.  
For primary bibliographic entry see Field 6G.  
W76-13049

#### DESCRIBING VARIANCE WITH A SIMPLE WATER QUALITY MODEL AND HYPOTHETICAL SAMPLING PROGRAMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W76-13162

#### OPTIMAL DESIGN OF CHLORINATION SYSTEMS,

Malviya Regional Engineering Coll., Jaipur (India).  
For primary bibliographic entry see Field 5F.  
W76-13163

#### DYNAMIC PROGRAMMING MODEL FOR WASTEWATER PLANT INVESTMENT,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-13164

#### OPTIMAL DESIGN OF WASTEWATER COLLECTION SYSTEMS,

Roorkee Univ. (India).  
For primary bibliographic entry see Field 5D.  
W76-13165

#### DESIGNING REGIONALIZED WASTE WATER TREATMENT SYSTEMS,

Ohio State Univ., Columbus. Department of Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W76-13166

#### DEVELOPMENT AND APPLICATION OF A WATER RESOURCE ALLOCATION MODEL,

Engineering-Science, Inc., Berkeley, Calif.  
For primary bibliographic entry see Field 5G.  
W76-13168

#### THE USE OF LINEAR PROGRAMMING TECHNIQUES FOR ESTIMATING THE BENEFITS FROM INCREASED ACCURACY OF WATER SUPPLY SYSTEMS,

Battelle Memorial Inst., Columbus, Ohio.  
J. L. Moore, and J. M. Armstrong.  
Water Resources Research, Vol. 12, No. 4, p 629-639, August 1976. 3 fig, 5 tab, 16 ref.

Descriptors: \*Water supply, \*Forecasting, \*Linear programming, \*Irrigation, \*Agriculture, \*Decision making, Optimization, Estimating, Benefits, Probability, Computer programs, Measurement, Assessment, Crops, Economics, Income methodology, Mathematical models, Systems analysis, Risks.  
Identifiers: \*Bayesian statistics, Crop planting, Net benefits, Model testing.

Probabilistic linear programming techniques and Bayesian statistics are combined in this paper by utilizing an example from the area of irrigated agriculture and water supply forecasts to assess the value of increased forecast accuracy to decision units. The case studied was confined to a two-period analysis involving (1) a crop planning period and (2) a growing and harvesting period. The model is developed in terms of Bayesian analysis and demonstrates how linear programming can be applied to rather complex decision making problems involving uncertainty. Testing of the model involved the use of an IBM computer program available at the University of Michigan. For

various assumptions as to supplemental water supply, the model showed a net benefit to irrigators of about \$6/acre for a reduction in uncertainty of 33% resulting from the introduction and improvement of water supply forecasts. (Bell-Cornell)  
W76-13169

## 6B. Evaluation Process

### HABITAT EVALUATION PROCEDURES.

Fish and Wildlife Service, Washington, D.C., Div. of Ecological Services.

For primary bibliographic entry see Field 6G.

W76-12845

### VALUE ENGINEERING: MAKE SURE THE COSTS ARE RIGHT.

Minges (James S.) and Associates, Inc., Farmington, Conn.

For primary bibliographic entry see Field 5D.

W76-12906

### EXAMPLE FOR REGIONAL PLANNING OF WATER QUALITY IN DENMARK (BEISPIEL EINER REGIONALEN PLANUNG DER GEWÄSSERQUALITÄT IN DÄNEMARK).

For primary bibliographic entry see Field 5G.

W76-12918

### ESTIMATES OF SOCIO-ECONOMIC DAMAGES OF AN OIL SPILL.

Institute for Water and Air Pollution Research, Stockholm (Sweden).

For primary bibliographic entry see Field 5G.

W76-12947

### THE ECONOMICS OF RECOVERY OF MATERIALS FROM INDUSTRIAL WASTE--A CASE STUDY.

Aston Univ., Birmingham (England). Dept. of Chemical Engineering.

For primary bibliographic entry see Field 5D.

W76-12948

### FIRST STAGES TOWARDS RANCHING SALMON ON OCEAN RANGES.

International Aquaculture Consultancy, Isle of Man (England).

T. Joyner.

Fishing News International, Vol. 15, No. 1, p. 20-24, 1976. 4 fig.

Descriptors: \*Salmon, \*Oceans, Fish hatcheries, Fish management, Fish migration, Fish stocking, Marine fisheries, Fish behavior, Fish farming, Law of the Sea, South America, Alaska, Ocean currents.

Identifiers: Aleutian Islands, Kurile Islands, Iceland, Falkland Islands, Kerguelen Islands, Chile, Southern Hemisphere.

The feasibility of deliberately modifying ocean fish stock composition and abundance is being realized. An International Law of the Sea must recognize the ocean as an open range that can be manipulated and managed to produce desirable crops. Management should be by an international regulatory body. Migratory stocks can be most efficiently harvested and managed at terminal fisheries in territorial water of coastal states. Salmon are considered the most suitable genus for a management system to take advantage of natural ocean range productivity. A ground-work for a management system would be a worldwide inventory of salmon rivers, production ranges, and potential for improvement of stocks. Saltwater rearing techniques indicate that migration and distribution of hatchery-bred salmon after release into a marine environment can be altered. Salmon hatcheries and nurseries could be established on

the southeastern Alaskan Archipelago, Aleutian Islands, Kurile Islands, Iceland, the southern extremity of South America, Falkland Islands, and Kerguelen Islands. An inshore terminal salmon fishery near the Strait of Magellan would be economically and ecologically attractive. Establishment of a system for hatching, rearing, planting, and recovering salmon in southern Chile would encourage development of an ocean range management system that could be incorporated into the Law of the Sea. (Buchanan-Davidson-Wisconsin).  
W76-12949

### DOES WATER USE RESTRICT THE LOCATION OF INDUSTRIAL AIR POLLUTERS.

Argonne National Lab., Ill.

For primary bibliographic entry see Field 5G.

W76-12950

### THE SOCIAL AND ECONOMIC IMPORTANCE OF THE CARONI SWAMP IN TRINIDAD AND TABAGO.

Michigan Univ., Ann Arbor. Dept. of Natural Resources.

For primary bibliographic entry see Field 6G.

W76-12952

### CONSERVATION: EESG BIBLIOGRAPHY SERIES:16.

Reading Univ. (England). Dept. of Economics.

M. J. Stabler.

EESG (Environmental Economics Study Group)

Bibliography Series 16, February 1975. 19 p. 216 ref.

Descriptors: \*Bibliographies, \*Conservation, \*Natural resources, \*Exploitation, \*Economic justification, \*Cost-benefit analysis, Social aspects, Industrial production, Projections, Energy, Welfare (Economics), Decision making, Legal aspects, Economic rent, Environment, Pollutants, Marine fisheries, Public rights, Evaluation.

Identifiers: \*Public policy.

The scope and nature of economic analysis of conservation of stock resources, amenity resources, the aspects of costs and effects of pollution, the preservation of wildlife and natural scenery, and the social costs of economic growth are reflected in 216 citations. The added dimension considered is the relationship between growth and environmental quality and the problem of conservation concerned with depletion of natural resources in connection with the energy crisis. Discussions evaluate the precise definition of conservation, its boundaries, and the interpretation of the intertemporal use of natural resources from an economic standpoint, decisions on the rate of utilization of resources, such as aspects of soil conservation, fishery, energy resources, pollution, ecology, and the quality of the environment, as well as the spatial analysis of conservation. Also covered is the concern for conservation of resources not only related to the problem of rate of utilization but where property rights are not clearly, or cannot be, defined, as for instance the fishery industry where the nature of the common property, the freedom of entry, and the dissipation of economic rent as a consequence of overutilization. Several citations discuss implicit and implied guidelines for public policy. (Auen-Wisconsin)  
W76-12953

### A CLUSTER ANALYSIS OF ACTIVITY, FREQUENCY, AND ENVIRONMENT VARIABLES TO IDENTIFY WATER-BASED RECREATION TYPES.

Wisconsin Univ., Green Bay. Urban Analysis.

R. B. Ditton, T. L. Goodale, and P. K. Johnsen.

Journal of Leisure Research, Vol. 7, No. 4, p. 282-295, 1975. 3 fig., 1 tab., 18 ref.

Descriptors: \*Recreation demand, \*Analytical techniques, \*Water users, Behavior, Recreation, Wisconsin, Great lakes, Spatial distribution, Statistical methods, Camping, Hunting, Swimming, Fishing, Water skiing, Boating, Water sports.

Identifiers: \*Recreation typology, \*Cluster analysis, Picnicking, Sailing.

Cluster analyses were used to establish relationships among individuals as determined by their recreation participation measurements, utilizing a sample of 250 of 2174 heads of households surveyed in northeastern Wisconsin. The first analysis identified eight mutually exclusive clusters of individuals, distinguished by the kind and frequency of their water-based recreation activity. The second analysis based on kind, frequency, and type of environment yielded nine clusters. Inclusion of the location variable added an important dimension to these analyses. Results suggest that in terms of distinguishing behavior, individuals may first relate to environments and choose activities secondarily. Large water bodies like the Great Lakes do not appear to be distinctive attractors of water-based activity for populations when other alternatives exist and the travel dimension is relatively constant. A large minority of clusters were distinguished by participation in open water environments, but the sheer size of these resources as well as their intensive access and facility development programs have not led to noticeable shifts in participation. Excluding distance concerns, other factors relating to means and access, such as cost and durability of equipment needed, weather, and seasonality, are involved in recreation choices. (Luedtke-Wisconsin)  
W76-12955

### BENEFITS OF AN EXTENDED SEASON: THE EXPERIENCES OF ONE INDUSTRIAL USER.

C. H. Boyd.

Seaway Review, Vol. 5, No. 2, p. 15-17, 1975.

Descriptors: \*Navigation, \*St. Lawrence Seaway, \*Great Lakes, \*Winter, \*Economic impact, Monetary benefits, Indirect benefits.

The Dow Chemical Company moved 20% of its 900,000 tons of product in 1974 through the Great Lakes-St. Lawrence Seaway system. Water transportation moves larger tonnages of product with more efficient fuel consumption and less environmental disturbance. Continued extension of the seaway season would conserve fuel and reduce capital expenditures. A 10-month season would eliminate the need for a \$5.7 million increase in storage capacities for the next three years. This money could be redirected toward plant expansion, thus creating new jobs and helping the economy. In 1974 Dow needed to deliver caustic soda to Thorold and Thunder Bay, which had low inventories. Alternate means of delivery would have increased shipping costs, and carrier equipment was difficult to acquire. Overland transportation would have cost \$600,000, water transportation only \$300,000. Therefore Dow is encouraging its Canadian customers to use storage facilities to take the product directly by water in the future. An extended navigation season can exert real anti-inflationary pressures on the economy. Based on the experiences of keeping the seaway open longer in 1974, Dow wants to keep a ship operational during the 1975 winter season and will help overcome problems in order to extend the season. (Buchanan-Davidson-Wisconsin)  
W76-12956

### HOW SRI LANKA PLANS TO DEVELOP HER FISHING INDUSTRY.

T. Driberg.

Fishing News International, Vol. 14, No. 10, p. 14-16, 1975.

Descriptors: \*Commercial fishing, \*Asia, \*Indian Ocean, Fishing gear, Fish harvest, Financing,



## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

Boats, Foreign trade, Training, Harbors, Refrigeration, Nets, Fish handling facilities, Aquaculture.  
Identifiers: \*Sri Lanka (Ceylon), Fishing fleet.

Sri Lanka is developing inland and marine off-shore fisheries to help meet threatened protein shortages. The Department of Fisheries was established with regulatory and development responsibilities. The present catch is largely from coastal fishing, some from inland fishing, with little deep-sea fishing. The boats used cannot operate in the 30-60 mile offshore range; there is a lack of private-sector enterprises to fish in this range; import of suitable boats is prevented by shortage of foreign exchange; and there is a scarcity of trained crews. Consultants have studied local conditions and developed boat designs which eliminate defects of previous boats. Two banks will extend credit to prospective buyers. The government is providing equipment for boat repairs. A new boat will have to be designed for skipjack fishing. Due to lack of foreign exchange, other supply avenues for obtaining trawlers are being investigated, such as joint ventures with foreign companies. Centers for training coastal fishermen, developing fish product markets, and research are being established. Harbors are being developed, refrigeration facilities increased, fishing nets manufactured, and shrimp and beche-de-mer processing plants opened. Inland fisheries are being encouraged and new fish species introduced. China and other countries are furnishing technical aid. (Buchanan-Davidson-Wisconsin)  
W76-12957

#### PLANNING FOR WATER RECREATION IN ISRAEL

Technion-Israel Inst., of Tech., Haifa. Center for Urban and Regional Studies.  
V. Kenyon, and R. Enis.  
Landscape Planning, Vol. 2, No. 1, p. 45-62, 1975. 6 fig., 6 tab.

Descriptors: \*Planning, \*Recreation, \*Water resources development, Multiple-purpose projects, Sites, Recreation facilities, Foreign countries, Lakes, Lake shores, Springs, Landscaping, Rivers, Beaches, Reclaimed water, Land uses, Water quality.  
Identifiers: \*Israel, Lake Kinneret (Israel), Sachne Springs (Israel), Hadera River (Israel), Dan Regional Sewage Scheme (Israel), Sequential water use.

Growing demand for outdoor recreation has placed heavy pressure on the limited water recreational sites in Israel. Its inland water resources are analyzed for their potential to meet the requirements of different recreational activities. Recreational water use is characterized by the different types of demands upon it as well as by relevant aesthetic and safety factors. Four different types of water resources are considered: water bodies or lakes, springs, rivers, and treated effluents. A planning approach utilizing one of three solutions, (a) multiple use of water, (b) sequential use of water, and (c) rationalization of land uses along water edges is illustrated. Specific cases described are lake Kinneret, which poses conflicting land and water use problems; Sachne, a sequential use of a spring; Nahal Hadera, the problem of the reorganization of a badly polluted river basin; and Dan Regional Sewage Scheme, the multiple use of improved effluent during the treatment process. It is proposed to integrate water based recreation areas into the national water planning system, developed primarily for agricultural, industrial, and domestic water supply, in order to evaluate alternative recreation sites and water projects throughout the country. (Luedtke-Wisconsin)  
W76-12959

SOLAR SEA POWER,  
Carnegie-Mellon Univ., Pittsburgh, Pa.  
C. Zener.

Bulletin of the Atomic Scientists, Vol. 32, No. 1, p. 17-24, 1976. 3 fig., 2 tab., 20 ref.

Descriptors: \*Oceans, \*Energy conversion, \*Electric power production, Tropic, \*Solar radiation, Feasibility studies, Economic feasibility, Design.  
Identifiers: \*Ocean thermal energy conversion.

The feasibility, efficiency, costs and climatic effects of ocean thermal energy conversion (OTEC) to electric power are discussed. A 300 ft diameter design (illustrated) would have an approximate capacity of 100 MW, or one-tenth the capacity of a nuclear or fossil fuel power plant. A network over the entire tropical ocean could supply the world's population in the year 2000 with per capita energy now consumed by the U.S. The operation of such systems is dependent, however, on costs, potential alternative uses of ocean surface, and environmental impacts. A design of an OTEC, using ammonia circulated in a closed cycle, has been found both technically feasible and economically attractive. An alternate concept of an open cycle OTEC is also being investigated. Estimates of an OTEC plant (in 1975 dollars) based on current technology, show cost at \$2100/KW as compared to \$800 of nuclear cost. Advances in evaporator, condenser, pumps and pipes, etc., are expected to reduce the baseline costs of these components to about \$450 from \$1100, before optimization. Reoptimization of the components would further cut costs to \$450/KW hour. Potential cost reductions also exist in appropriate site selection. An 25 MW module could be built and tested by 1981. (Auen-Wisconsin).  
W76-12961

ENVIRONMENT AND SOCIAL CLASS, EESG BIBLIOGRAPHY SERIES 15.  
Bristol Univ. (England). Dept. of Economics.  
EESG (Environmental Economics Study Group) Bibliography Series 15, (undated). 3 p. 39 ref.

Descriptors: \*Bibliographies, \*Environment, \*Income distribution, \*Social aspects, Economics, Industrial production, Economic efficiency, Equity, Attitudes, Welfare (Economics), Air pollution, Social values, Urban sociology.  
Identifiers: \*Public policy, Noise pollution.

The general aspects of environmental protection as related to income distribution are discussed in 39 citations. Related discussions deal with the effects of economic growth, economic issues in planning urban recreation facilities, social class attitudes to air, noise, and water pollution, and congestion vs. welfare. The theory on choosing policies to reconcile distribution and allocation objectives making explicit use of a social welfare function, and the efficiency and equity in national resource and environmental policy are also cited. Industrial growth, the costs of growth, and a review of possible treatments of income distribution in cost-benefit analysis, are among the pertinent subjects. (Auen-Wisconsin)  
W76-12962

WISCONSIN ANNUAL REPORT 1975,  
Upper Great Lakes Regional Commission, Madison, Wis.  
P. J. Lucey.  
(1976), 76 p.

Descriptors: \*Wisconsin, \*Interstate commissions, \*Regional development, Transportation, Mining, Financing, Employment, Agricultural runoff, water pollution control, Waste treatment, Cattle, Fisheries, \*Great Lakes Region, Marketing, Forest management, Training, Recreation, Grants, Future planning (Projected).

The economic development through technical assistance and supplemental grants implemented by the Wisconsin Office of the Upper Great Lakes Regional Commission in the 36-county region of

northern and central Wisconsin is described. Some representative projects were the development of industrial parks and improvements to existing industrial areas such as water and sewer improvements. It is estimated that these improvements will result in 2200 to 2300 new jobs and help retain an additional 300 to 400 jobs over the next three or four years. The Commission also supports business and management consulting services. Financial aid was provided for Wisconsin Railroads, air transportation and selected bridge projects to aid industry and passenger service. Demonstration projects in soil conservation practices to reduce agricultural runoff, farm waste management, and a survey of ore deposits were conducted. A dairy beef program demonstrates farm management, marketing, and increased production. Commercial fishermen were assisted by a project to increase use of certain fish species and better means of utilizing fish wastes, management, and marketing. Forest management information is disseminated as well as the promotion of recreation and tourism. The goals for the next three-year plan are described and funding requirements are indicated. (Auen-Wisconsin).  
W76-12964

IMPACTS OF RECREATIONAL DEVELOPMENT: THE VOYAGER VILLAGE EXPERIENCE,  
Wisconsin Planning Office, Madison.  
C. Deknatel.  
February 1975. 14 p. 6 fig.

Descriptors: \*Community development, \*Recreation, \*Lake shores, Planning, Septic tanks, \*Wisconsin, Rural areas, Local governments, Land use, Zoning, Economic impact, Environmental effects.  
Identifiers: \*Voyager Village (Wis), Burnett County (Wis), Recreation homes, Lakeshore property development.

The controversy surrounding the early development of Voyager Village, a 6000 acre second home development in eastern Burnett County, Wisconsin, is described. The Voyager Village proposal called for approximately 4000 lots of 20,000 square feet each. Approximately 50% of the total acreage was to be maintained as open space or used for community facilities including a clubhouse, stables, and ski chalet. It was expected to attract a population of about 10,000-13,000 when fully developed, in contrast to the Burnett County's permanent population of about 10,000. Opposition arose from some permanent residents of the area as well as second-home-owners already there. Their basic concerns were the increased traffic, loss of natural resources, crowding, service costs, lake pollution from septic tank seepage, shoreline erosion, road runoff and increased use of boats. The conflict between these groups, exemplified in its most concrete form by the Webb Lake Township's subdivision ordinance intended to limit large-scale development, was sustained over a period of years. While a number of state agencies were involved in specific aspects of the development question, the broader issue of how natural resources may best be used was never addressed at the state level. Ultimately, most aspects of Voyager Village were developed, with some modification. (Luedtke-Wisconsin).  
W76-12965

PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEER DISTRICTS-SUMMARY OF EVALUATION AND RECOMMENDATIONS,  
Ragan (James) Associates, Pacific Palisades, Calif.  
For primary bibliographic entry see Field 6E.  
W76-13041

**PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEERS DISTRICTS.**

Ragan (James) Associates, Pacific Palisades, Calif.

For primary bibliographic entry see Field 6E.  
W76-13042

**A PROPOSED METHODOLOGY FOR ASSESSING ALTERNATIVE TECHNOLOGIES.**

Cornell Univ., Ithaca, N. Y. Program on Science, Technology and Society.

For primary bibliographic entry see Field 6G.  
W76-13049

**PUBLIC EVALUATION OF WATER QUALITY AND ITS IMPACT ON RECREATION: A CASE FROM IOWA.**

Waterloo Univ., (Ontario). Dept. of Geography.

For primary bibliographic entry see Field 5G.  
W76-13050

**DEVELOPMENT OF RESIDUALS MANAGEMENT STRATEGIES: AN EXECUTIVE SUMMARY.**

Indiana Univ., Bloomington. School of Public and Environmental Affairs.

For primary bibliographic entry see Field 5G.  
W76-13054

**PROFESSIONAL BIAS AND WATER REUSE.**

George Williams Coll., Downers Grove, Ill.

For primary bibliographic entry see Field 5G.  
W76-13096

**SEAFOOD PROCESSING IN RELATION TO COASTAL INDUSTRIAL PARK CONCEPTS.**

North Carolina State Univ., Raleigh. Dept. of Food Science.

F. B. Thomas.

In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 27-28.

Descriptors: \*Fish handling facilities, \*Marine fish, \*Industries, \*Optimization, Transportation, Economic feasibility, Planning, Waste treatment, Coasts.

Identifiers: \*Seafood industrial parks.

The feasibility and benefits of establishing seafood industrial parks along the South Atlantic seaboard are outlined. The requirements are the provision of adequate deep water access, channelization, and stabilization; sufficient land area should be available for all primary and secondary needs, with adequate transportation facilities, utilities, labor resources, with concomitant parking, bulkhead, docking, fire protection, fuel, ice, ship stores, engine and electronic repair facilities. Consolidation of goods and services can reduce capital expense for support facilities. The benefits are that the shortest time possible between fish harvest and consumption tends to promote better product quality; short boat turn-around time, and simplified inspection. Solid and liquid waste treatment and disposal, and product recovery can be consolidated both from processing plants and boats. Efficient production tends to attract processors and sufficient volume draws satellite industries, such as packaging materials, equipment and cordage, etc. Freezing facilities can be better managed under consolidation. The seafood industrial park can provide opportunities to assist fisheries cooperatives, municipal and state governments, and increase utilization of proteins from the sea while reducing waste. The concept promises a remarkable opportunity for enhancing the seafood handling industry and regional economic development. (See also W76-09329) (Auen-Wisconsin)  
W76-13101

**6C. Cost Allocation, Cost Sharing, Pricing/Repayment**

**CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING AS LOW AS PRACTICABLE GUIDES-FABRICATION OF LIGHT-WATER REACTOR FUELS CONTAINING PLUTONIUM.**

Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 5C.  
W76-12694

**MEADOW/MARSH SYSTEMS AS SEWAGE TREATMENT PLANTS.**

Brookhaven National Lab., Upton, N. Y.

For primary bibliographic entry see Field 5D.  
W76-12753

**THE IMPACT OF INCREASED FUEL COSTS AND INFLATION ON THE COST OF DESALTING SEA WATER AND BRACKISH WATERS.**

Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 3A.  
W76-12778

**ECONOMIC EVALUATION OF THE PROMULGATED INTERIM PRIMARY DRINKING WATER REGULATIONS.**

Energy Resources Co., Inc., Cambridge, Mass.

For primary bibliographic entry see Field 5G.  
W76-12821

**ECONOMIC EVALUATION OF THE PROPOSED INTERIM PRIMARY DRINKING WATER REGULATIONS.**

Energy Resources Co., Inc., Cambridge, Mass.

For primary bibliographic entry see Field 5G.  
W76-12822

**TURBULENT BED COOLING TOWER.**

Purdue Univ., Lafayette, Ind.

For primary bibliographic entry see Field 5D.  
W76-12847

**VALUE ENGINEERING: MAKE SURE THE COSTS ARE RIGHT.**

Minges (James S.) and Associates, Inc., Farmington, Conn.

For primary bibliographic entry see Field 5D.  
W76-12906

**ESTIMATES OF SOCIO-ECONOMIC DAMAGES OF AN OIL SPILL.**

Institute for Water and Air Pollution Research, Stockholm (Sweden).

For primary bibliographic entry see Field 5G.  
W76-12947

**THE ECONOMICS OF RECOVERY OF MATERIALS FROM INDUSTRIAL WASTE--A CASE STUDY.**

Aston Univ., Birmingham (England). Dept. of Chemical Engineering.

For primary bibliographic entry see Field 5D.  
W76-12948

**SUMMARY OF THE REPORT OF THE DANIEL COMMITTEE OF INQUIRY INTO WATER CHARGES.**

Water Services, Vol. 79, No. 955, p. 361-362, 1975.

Descriptors: \*Water rates, \*Pricing, \*Water policy, Water demand, Water utilization, Legislation, Water allocation(Policy), Regulation, Domestic water, Industrial water, Sprinkler irrigation, Financing, Cost allocation, Europe.

Identifiers: England, Wales, Welsh National Water Development Authority.

The background, 1974-75 water charges, future pricing policy, relation to other water authorities, area, and accountability of the Welsh National Water Development Authority (WNWDA) are summarized. It is concluded that the Water Act of 1973 has produced an excessive difference in the average level of water charges between the WNWDA and other water authorities which should be reduced by legislation. Recommendations include giving a Welsh Assembly executive responsibility for water supplies in Wales and pricing transferred water on a commercial basis, or is the present organization is sustained the scope of commercial pricing should be extended or a levy-subsidy scheme should be developed to reduce charges to WNWDA consumers to within 10% of the national average. The necessity of these steps is based on the conclusion that providing water to consumers in rural areas such as Wales is inherently more expensive than supplying urban districts in England. (Luedtke-Wisconsin)  
W76-12958

**SOLAR SEA POWER.**

Carnegie-Mellon Univ., Pittsburgh, Pa.

For primary bibliographic entry see Field 6B.  
W76-12961

**WATER POLLUTION, EESG BIBLIOGRAPHY SERIES: 17.**

Newcastle-upon-Tyne (England). Center for Research in Public and Industrial Economics.

For primary bibliographic entry see Field 5G.  
W76-12963

**ICELAND'S WINTER COD CATCH SHOWS SERIOUS DECLINE.**

D. Glen.

Fishing News International, Vol. 14, No. 12, p. 17-18, 1975.

Descriptors: \*Fish harvest, \*Demersal fish, Protection, Marketing, Crustaceans, Foreign countries, Tariff, International waters, Export, Freezing.

Identifiers: \*Iceland, \*Codfish.

Icelandic demersal fish catches and codfish landings have recently been decreasing. Iceland has declared a 200-mile fishing limit, because they believe that overfishing of cod, especially immature fish, by foreign trawlers is causing the decline. By allowing fish to grow and accumulate more weight and spawn at least once, the annual yield should increase. More than 100 species of fish have been found near Iceland, which is located at the convergence of the warm Gulf Stream and cold, nutrient-bearing Arctic currents. About 15-20 species are commercially valuable. Cod, then saithe (coley), ocean perch (redfish), haddock, and catfish are especially important. Flatfish (plaice, Greenland halibut, lemon sole, witches, and megrins) are also caught. There is concern that foreign trawlers may be depleting plaice stocks, so protective measures are proposed. Markets for the various species vary. At present flatfish are frozen whole and not filleted, but Britain has increased tariffs on whole fish, so this may change. The nephrod (Norway lobster tails) market is very lucrative. Fishing for lobster is closely protected and a strict quota enforced. A 12% British import tariff on shrimp has slowed the shrimp fishery. A new profitable product is the scallop. (Buchanan-Davidson-Wisconsin).  
W76-12966

**PRELIMINARY ASSESSMENT OF SYSTEMS FOR DERIVING LIQUID AND GASEOUS FUELS FROM WASTE OR GROWN ORGANICS.**

National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.

## Field 6—WATER RESOURCES PLANNING

### Group 6C—Cost Allocation, Cost Sharing, Pricing/Repayment

For primary bibliographic entry see Field 5D.  
W76-12967

**SOLAR ENERGY FIXATION AND CONVERSION WITH ALGAL BACTERIAL SYSTEMS,**  
California Univ., Berkeley. Sanitary Engineering Research Lab.

For primary bibliographic entry see Field 5D.  
W76-12968

**WICHITA FALLS IMIS PROJECT. WATER UTILITY PROCESSING SYSTEM APPLICATION EVALUATION REPORT,**  
Kansas Univ., Lawrence. Inst. for Social and Environmental Studies.

For primary bibliographic entry see Field 3D.  
W76-13040

**OPERATION AND IMPACT OF NPDES IN REGION II, PART 2,**  
Environmental Protection Agency, New York. Caribbean Construction Grants Branch.

For primary bibliographic entry see Field 5G.  
W76-13059

**THE BUDDING ENVIRONMENTAL CLEAN-UP (A VIEWPOINT): PART II. CLEAN UP, COSTS AND GROWTH,**  
Northeastern Illinois Univ., Chicago. Dept. of Earth Sciences.

For primary bibliographic entry see Field 5G.  
W76-13098

**SHRIMP SUPPLIES IN THE SOUTHEAST AND THEIR EFFECT ON PROCESSING FIRM SIZE,**  
Florida Univ., Gainesville. Dept. of Food and Resource Economics.

J. C. Cato.  
In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 37-39.

Descriptors: \*Industries, \*Fish handling facilities, \*Southeast U.S., \*Florida, Economic impact, Import, Industrial production, Fish harvest.

Identifiers: Shrimp harvest deficit.

The growing deficit in the domestic shrimp supply and its effect on the shrimp processing industry in the Southeast are discussed. Shrimp products accounted for \$89 million, representing 61% of all seafood processed in the region and 76% of all shrimp processed in the U.S. in 1973. While the processing industry has been growing, shrimp landings in Florida have declined from about 50 million pounds in 1960 to almost one-half, due primarily to a change in landing patterns and structural changes within the industry. The declined shrimp supply promotes Mexican and Indian imports, which have increased substantially. The supply problem has affected the historical entry-exit patterns of firms in the industry; new entrants and existing processors must make a careful choice of product lines, plant locations, size of operations, and consider increased transportation costs. Entry of small firms into the industry will be enhanced if they have an isolated market and/or produce a specialty product. Large and small firms will be much more viable than medium size firms. The Florida shrimp processing industry will reach an equilibrium of 19 in 1985. The number of small firms will increase, medium size firms will decline, and the number of large firms will remain stable. (See also W76-09329) (Auen-Wisconsin)

W76-13103

**DYNAMIC PROGRAMMING MODEL FOR WASTEWATER PLANT INVESTMENT,**  
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5D.  
W76-13164

**OPTIMAL DESIGN OF WASTEWATER COLLECTION SYSTEMS,**  
Roorkee Univ. (India).

For primary bibliographic entry see Field 5D.  
W76-13165

**DEVELOPMENT AND APPLICATION OF A WATER RESOURCE ALLOCATION MODEL,**  
Engineering-Science, Inc., Berkeley, Calif.

For primary bibliographic entry see Field 5G.  
W76-13168

### 6D. Water Demand

**A NON-LINEAR PROGRAMMING MODEL FOR EVALUATING WATER SUPPLY POLICIES IN THE TEXAS COASTAL ZONE,**  
Texas Univ. at Austin.

R. A. Rios.  
Available from University Microfilms, Inc., Ann Arbor, Mich., 48106. Order No. 76-8095. Ph.D. Thesis, 1975, 123 p.

Descriptors: \*Water supply, \*Water users, \*Municipal water, \*Industrial water, \*Model studies, Water resources development, Water reuse, Water policy, Coasts, \*Texas, \*Water demand.

Identifiers: Non-linear programming models, Corpus Christi(Tex).

The water supply in Corpus Christi, Texas, could become a constraint on the area's development due to limits of available industrial and municipal supplies. A non-linear model was used for determining the quantity of fresh water needed for future demands and evaluating alternate methods to reduce demand on the primary source. In 1974 the use of the available water resources was less than optimal. Three policies for reducing water demand were studied. These increased fresh water and effluent disposal costs for various groups of users under specific conditions. Uniformly increasing the fresh water cost for all users produced maximum recycle and effluent reuse, resulting in zero discharge of waste water. The total system cost was increased most by this uniform increase. Increasing fresh water cost for industry only produced zero discharge for industrial waste water, but not zero discharge, since no economic incentive for reusing municipal waste water was provided. An effluent tax increasing disposal cost also produced zero discharge for industrial waste water, but reduced municipal demand less than the other policies did. About one-third reduction in total demand could be achieved. These policies would raise waste water treatment and fresh water supply costs considerably, but total costs would still be approximately 1 to 2% of the gross output of the industrial sector in the area. (Snyder-FIRL)

W76-12680

**A PLAN FOR STUDY OF WATER AND ITS RELATION TO ECONOMIC DEVELOPMENT IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING,**  
Geological Survey, Cheyenne, Wyo.

H. W. Lowham, L. L. De Long, and K. D. Peter, et al.  
Open-file report 76-349, May 1976. 92 p, 37 fig, 11 tab, 73 ref.

Descriptors: \*Water resources development, \*Water demand, \*Water quality, \*Hydrologic data, \*Wyoming, Projections, Available water, Surface waters, Groundwater resources, Water yield, Chemical analysis, Data collections, Mining, Economic prediction.

Identifiers: \*Great Divide Basins(Wyo), \*Green River(Wyo).

Development of extensive coal, oil, gas, trona, and oil-shale resources as well as other developments in the Green River and Great Divide Basins in Wyoming will require a projected increase in

water consumption of 490,000 acre-ft per year by 2020. Developments of energy resources in other parts of Wyoming will also require large amounts of water; transbasin diversion of Green River water to other areas could total an additional 270,000 acre-ft per year. In anticipation of this increased demand, water planners and managers need much more information about available ground and surface waters, present quality of the waters, and hydrologic effects that would be caused by development of energy resources. The U.S. Geological Survey is conducting an extensive hydrologic study of the basins. This report summarizes the study plan and discusses particular methods of approach that would be utilized in the study. Regarding water quality, particular attention is being given to trace metals, biological characteristics, and trend analyses of salinity. Channel-geometry techniques, detailed statistical analyses, and mathematical models are being applied to surface-water studies. An updated well inventory, aquifer tests, and borehole and surface geophysical surveys are being used in ground-water studies. (Woodard-USGS)

W76-12805

**EXAMPLE FOR REGIONAL PLANNING OF WATER QUALITY IN DENMARK (BEISPIEL EINE REGIONALE PLANUNG DER GEWÄSSERQUALITÄT IN DÄNEMARK),**  
For primary bibliographic entry see Field 5G.  
W76-12918

**PLANNING FOR WATER RECREATION IN ISRAEL,**  
Technion-Israel Inst., of Tech., Haifa. Center for Urban and Regional Studies.

For primary bibliographic entry see Field 6B.  
W76-12959

**MEETING FUTURE WATER REQUIREMENTS BY WATER CONSERVATION,**  
Soil Conservation Service, Golden, Colo.  
For primary bibliographic entry see Field 3F.  
W76-13013

**MORE WATER: ONE CITY'S PLAN,**  
Henningson, Durham and Richardson, Inc., Henderson, Tex.  
W. Haygood, and R. B. Stokes.  
Water and Sewage Works, Vol 122, No 12, p 54-56, 1975. 1 fig, 1 tab.

Descriptors: \*Water resources, \*Cities, \*Future planning(Projected), \*Water supply, \*Texas, Water wells, Population, Projections, Reservoirs, Water demand, Groundwater resources, Water storage, Water distribution(Applied).

Identifiers: \*Henderson(Texas).

A long-range water supply development plan for Henderson, Texas, includes development of the existing water well system to its ultimate capacity and alternatives for future surface water supplies based on population projections for future water demands. Projections indicate that the average daily demand in 1995 will be 2.82 mgd with a maximum of 6.2 mgd; for 2025 it is projected that the demand will be 5.32 mgd with a maximum of 11.71 mgd. The total water supply capacity available is approximately 7.3 mgd. Existing wells will be adequate beyond 1995 if developed to full capacity and maintained in good operating condition. Water should be pumped into ground storage tanks from wells rather than directly into the distribution system to enable the well to produce its maximum rated capacity. Future wells should be drilled east of the city, properly spaced, and piped to ground storage facilities. New water mains and storage tanks should be installed as additional wells are developed. Negotiations with the Texas Utilities Services, Inc., should be conducted to determine the feasibility of utilizing their proposed reservoir as a municipal water supply. Construction of a



multiple raw water intake structure prior to the construction of that reservoir should assure a virtually unlimited water supply in the future. (Buchanan-Davidson-Wisconsin) W76-13097

## 6E. Water Law and Institutions

### PLAN OF WORK, RED RIVER BASIN ABOVE DENISON DAM.

Soil Conservation Service, Temple, Tex.  
For primary bibliographic entry see Field 4A.  
W76-12816

### WHAT DO WE DO ABOUT THE WATER POLLUTION CONTROL ACT.

Watson and Co., Tampa, Fla. Environmental Services Div.  
For primary bibliographic entry see Field 5G.  
W76-13037

### PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEER DISTRICTS-SUMMARY OF EVALUATION AND RECOMMENDATIONS.

Ragan (James) Associates, Pacific Palisades, Calif.  
J.F. Ragan.  
Army Engineer Institute for Water Resources, Ft. Belvoir, Va., Supplement to IWR Contract Report 75-6, November 1975. 54 p.

Descriptors: \*Evaluation, \*Planning, \*Water resources development, \*Decision making, \*Management, \*Financing, \*Human resources, \*Social participation, \*Coordination.  
Identifiers: \*Public participation, \*Public information, \*Agency coordination, \*Army Corps of engineer districts.

A commitment to public participation in water resources planning was reemphasized by the Corps of Engineers. To achieve this end, the Corps issued a process to evaluate its own performance. Eight criteria for evaluation are as follows: the extent to which (1) recommended plans satisfy community-expressed needs and desires, (2) field offices present study information to the public to increase understanding and elicit meaningful comments, (3) field offices provide the public with opportunities to express itself and influence planning decisions, (4) the Corps coordinates its planning efforts with other agencies, (5) public participation is integrated into field office planning processes, (6) field office organization and management facilitate public participation, (7) field offices have adequate financial and human resources to implement effective programs, (8) central and field personnel have committed themselves to applying the objectives of maximum public participation. A total of 31 recommendations were presented for improving the effectiveness of public participation in water resources planning; for example, field offices should (1) identify publics for each study according to interest and location in addition to organizational type; (2) develop ways to insure feedback to the public as the study progresses; and (3) provide information intended for public comment to all interested individuals at least a week before all meetings. (See also W76-13042) (Gentry-North Carolina) W76-13041

### PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING: AN EVALUATION OF THE PROGRAMS OF 15 CORPS OF ENGINEER DISTRICTS.

Ragan (James) Associates, Pacific Palisades, Calif.  
J.F. Ragan, Jr.

Submitted to the U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia. IWR Contract Report 75-6, November 1975. 219 p. 2 append.

Descriptors: \*Evaluation, \*Planning, \*Water resources development, \*Project planning, \*Decision making, Public rights, Institutions, Management, Social aspects, \*Social participation.  
Identifiers: \*Public participation, \*Army Corps of Engineer districts.

This report evaluates current (1973) public participation practices in U.S. Army Corps of Engineer offices and provides planners with specific experiential guidance on how to integrate increased participation into planning. Part one describes programs in 13 districts, none of which regularly or systematically plan for public participation. The purposes of participation, identification of publics, and various participation techniques are discussed in general terms. The programs of the Seattle District, the only field office which systematically tries to involve the public in all its studies, and the Rock Island District, which initiated additional techniques to supplement mandated public meetings, are discussed in some detail. Part 2 concerns organizing for effective participation. It is stressed that participation must be made an integral part of district policy in order for it to be effective. There must be a commitment to public involvement and an organizational structure which facilitates this. Adequate resources must be available. Part 3 details the planning process: preparing study plans, identifying problems and needs, formulating alternatives, analyzing impacts, and evaluating impacts. District programs are analyzed in relation to these 5 study phases and recommendations for improvements are made in each section. Part 4 deals with other participation issues, including participation in post-authorization planning, and constraints which the Corps and the public place on public participation. (See also W76-13041) (Smith-North Carolina) W76-13042

### ANNUAL REPORT FOR THE YEAR ENDING MARCH 31, 1975, SASKATCHEWAN DEPARTMENT OF THE ENVIRONMENT.

Saskatchewan Dept. of the Environment, Regina.  
March 31, 1975. 51 p. 16 fig. 3 plates, 6 tab.

Descriptors: \*Floods, \*Water supply, \*Water pollution, \*Environment, \*Groundwater, Research, Land use, Planning, River basins, Air pollution, Water quality, \*Water rights, \*Canada.  
Identifiers: \*Qu'Appelle River Basin(Sask), Saskatchewan River(Sask).

Objectives and activities of different agency branches are described. Hydrology branch, which carries out reservoir and river system operation planning and stream-flow forecasting and collects basic hydrometric, meteorological, snow survey, sedimentation and allied data, reported that floods from extremely heavy spring snow melt caused some 20,000 acres of flood plain agricultural lands in the Qu'Appelle River Basin to be under water all summer with Moose Jaw having major flooding. Floods also affected areas of the Souris River and Saskatchewan River Basins. The Water Rights branch grants licenses for use of surface and ground water resources, estimates ground water storage and investigates other aspects of water rights. At present less than 1% of total ground-water storage capacity is pumped every day, far less than seeps into the ground. Flows into the U.S. from Lodge Creek, Battle Creek, Frenchman River and the Souris River exceeded the 50% allotted by the International Joint Commission. A major undertaking was the beginning of implementation of the Qu'Appelle Basin Study Report. Initiation of flood protection plans involved meetings with town and village councils to consider proposals for a large reservoir and a diversion channel east of Moose Jaw. Environmental

Protection Service contains branches of Air Pollution Control, Water Pollution Control including water quality monitoring, and Land Protection. Policy, Planning and Research Branch develops and coordinates environmental research programs. Systems and Computer Section and Administration Branch serve the other branches. (Smith-North Carolina) W76-13052

### THE BUDDING ENVIRONMENTAL CLEAN-UP (A VIEWPOINT): PART II. CLEAN UP, COSTS AND GROWTH.

Northeastern Illinois Univ., Chicago. Dept. of Earth Sciences.  
For primary bibliographic entry see Field 5G.  
W76-13098

### THE VIRGINIA INSTITUTE OF MARINE SCIENCE, VIRGINIA'S MARINE SCIENCE, ENGINEERING, EDUCATION, AND ADVISORY SERVICES PROGRAM.

Virginia Inst. of Marine Science, Gloucester Point. W. J. Hargis.  
In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p.9-13. 2 fig.

Descriptors: \*Research facilities, \*Virginia, Resources development, Continental Shelf, Coasts, Continental Slope, Oceanography, Education.

Identifiers: Virginia Institute of Marine Science, \*Coastal zone management, Marine resources.

The functions and scope of the Virginia Institute of Marine Science, created by Commonwealth legislative mandate, functions to maximize use of the marine resources and environments for the public welfare, to maintain their quality and to conserve resources for the future. In this context its principal tasks are to do research and engineering development on the marine resources and their uses; to provide advisory and technical services; and to provide education in all areas of marine resources and their uses; to provide education in all areas of marine science and conservation. The operational area includes all of the tidal waters of Virginia and the adjacent Atlantic Ocean. VIMS's products are knowledge, advice and other technical assistance to decision-makers, including the Commonwealth General Assembly, executive agencies, industry and the public. The Institute's current focus is on coastal zone management; Outer Continental Shelf oil and gas development; fishery management improvements; resource inventory preparation; environmental baseline and inventory preparation; wetlands preservation and management; environmental impact statements; ocean dumping and pollution; and advisory services and technical assistance programs to public and private managers and users. (See also W76-09329) (Auen-Wisconsin) W76-13100

### LEGAL ASPECTS OF PUBLIC ACCESS TO BEACHES.

Hartzog, Lader, and Richards, Hilton Head Island, S.C.  
P. Lader.

In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p.41-53. 73 ref.

Descriptors: \*Beaches, \*Public access, \*Legal aspects, \*Seashores, Public rights, Recreation, Coastal Plains, Prescriptive rights, Easements, Condemnation, Contracts, Zoning, Regulation, Compensation, Littoral.

Identifiers: \*Coastal zone management, Tide-lands.

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

To the extent that the demand for additional public access to beaches in the Coastal Plains Region can be met by government acquisition and traditional exercise of the police power, no extraordinary remedies are needed. But since state and local treasuries often cannot meet the needs created by national recreational goals of states' coasts, the expansion of beach recreation opportunities will likely require the use of historic legal doctrines and innovative legal mechanisms, which must also withstand the challenges of the constitutional prescription against uncompensated takings and the traditional understandings of the police power. Thus combinations of acquisition, regulation, and common law evolution are required. The discussion examines the common law tradition as related to the Public Trust Doctrine; beach acquisition by conservation regulations and easements; the police power and the taking issue; land use controls; the compensation mechanisms; and the role of the federal and state regulatory agencies. Legislative enactments by Texas, California, Washington, New Hampshire, Florida, Connecticut, Delaware, Hawaii, Louisiana, New Jersey, North Carolina and Rhode Island directed toward beach acquisition illustrate various approaches. (See also W76-09329) (Auen-Wisconsin)

W76-13104

#### BACK BAY NATIONAL WILDLIFE REFUGE. SOME PARALLELS IN IMPLEMENTING THE COASTAL ZONE MANAGEMENT ACT, Back Bay National Wildlife Refuge, Virginia Beach, Va.

D. F. Holland.  
In: Coastal Plains Center for Marine Development Service 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 55-60.

Descriptors: \*Public access, \*Conservation, \*Beaches, \*Seashores, Access routes, Attitudes, Recreation, Boundary disputes, National Wildlife Refuges, \*Virginia, North Carolina, Legal aspects. Identifiers: \*Coastal zone management, Back Bay Wildlife Refuge (Va).

The public opposition, legal contentions, and court decisions generated by the establishment of the Back Bay National Wildlife Refuge in Virginia, are cited as parallel impediments to be anticipated in coastal beach acquisition, planning, and management under P.L. 92-583, specifically as related to (1) inventory and designation of areas of concern, (2) priority of uses, (3) determination of permissible uses, and (4) the control of those uses. Up to the early 1950s no public access was available to the Refuge; but shortly after paving one road, summer homes began to multiply and real estate developments began to proliferate. By 1969 beach traffic and its attendant problems of litter, drunkenness, vandalism, car abandonment, accidents, theft and assaults were totally beyond the abilities of the Refuge management to control. Consequently, the Fish and Wildlife Service of the Department of the Interior imposed restrictions on vehicular access. A civil action was instituted by the local opposition to the restriction in the Federal District Court, with a hearing set for April 1973. The result was a temporary injunction on the restriction based on the plaintiffs' contentions of invalidity. That contention was set aside in 1975 in a strong ruling for the Department of the Interior. The experience showed that public use patterns are directly related to vehicular access. (See also W76-09329) (Auen-Wisconsin)

W76-13105

#### FREEING THE BEACHES: IS IT POSSIBLE, Bureau of Outdoor Recreation, Atlanta, Ga. Southeast Regional Office.

R. M. Baker.  
In: Coastal Plains Center for Marine Development Service 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 61-64.

Descriptors: \*Beaches, \*Public rights, \*Trespass, \*Legal aspects, Public lands, Public access, Connecticut, Recreation, Seashores, High water mark, Right of Way, Easements, Adverse possession, Repulsion (Legal aspects), Zoning, Compensation. Identifiers: \*Coastal zone management, Public trust doctrine, Customary rights.

How rights to beaches already in public use can be retained, public access, and rights to new land gained (in addition to the Bureau of Reclamation's grant role) are suggested. South Carolina, Georgia, and Florida have applied the public trust doctrine to beach acquisition. A New Jersey decision ruled against excessive use charges on the interpretation that beaches and open waters must be open to all on an equal basis. Another concept that can be employed is 'Implied Dedication', which governs donations of land for public use; or else 'Adverse Use' may provide the key to beach acquisition. Oregon and California use the 'Customary Rights' device to insure the public's right to beaches by negating the private owner's right to exclude the public. Another stratagem is creation of a public easement under 'Prescriptive Rights'; or the 'Subdivision Exaction'—a requirement that forces a developer to dedicate a public easement. 'Exclusive Use Zoning', which constructs a zoning district permitting only recreational and ancillary open space uses, is another device that can be applied. Donations of land can be encouraged by demonstrating potential tax advantages. Another option is 'Compensable Regulations', where the State regulates land then compensates landowners for losses. Court rulings may be favorable in all these cases under the broad umbrella of public safety, and the preservation or conservation of a unique natural area. (See also W76-09329) (Auen-Wisconsin)

W76-13106

#### THE ROLE OF INTERSTATE COMPACTS IN FISHERIES MANAGEMENT,

Atlantic States Marine Fisheries Commission, Washington, D.C.

I. M. Alperin.  
In: Coastal Plains Center for Marine Development Service 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 65-68.

Descriptors: \*Marine fisheries, \*Interstate compacts, \*Institutions, \*Interstate commissions, Fish management, Shrimp, Planning, Federal government, State governments, Jurisdiction. Identifiers: \*Coastal fisheries management.

The Atlantic States Marine Fisheries Commission shares with the Coastal Plains Regional Commission the five states, Virginia to Florida. The purpose of the ASMFC, as well as of the Gulf States and Pacific Marine Fisheries Commissions, is to provide for better utilization of fisheries along the seaboard. Recently these interstate compact commissions have come forth in support of a new initiative—the State-Federal Fisheries Management Program—in which the commissions play a supportive role in communications, planning, coordination and administration of the SFFMP, resulting in a cooperative effort involving the commissions as regulatory (management) institutions with state and federal administrators and scientists providing financial and technical input while the states practice reciprocal enforcement. This institutional arrangement is viewed as a practical solution to regional fisheries management. However, the viability of the commissions is threatened by House and Senate bills currently under consideration, which propose establishment of regional management councils and which would usurp the states rights and needs. The states oppose the ultimate powers vested in the Secretary of Commerce, the large council structure, and feel that federal licensing will deprive them of funds upon which they depend to support their own fisheries research and management programs. It is proposed that the interstate commissions should

retain their identities as State-funded and State-governed entities. (See also W76-09329) (Auen-Wisconsin)

W76-13107

#### STATE-FEDERAL MANAGEMENT PLANNING FOR MARINE FISHERIES: TODAY AND TOMORROW,

National Marine Fisheries Service, Washington, D.C. Fisheries Management Div.

R. H. Schaefer.  
In: Coastal Plains Center for Marine Development Service 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 69-72.

Descriptors: \*Marine fisheries, \*State jurisdiction, \*Federal jurisdiction, Management, Governmental interrelations, Planning, Regulation, Institutions. Identifiers: 200-mile fishery zone, 3-mile territorial sea.

The State-Federal Fisheries Management Program (SFFMP) is designed to effect the rational management of domestic inter-jurisdictional fisheries by developing and implementing comprehensive management plans and to promulgate legislation. HR 200 and S. 961, each provides for a 200-mile U.S. fisheries zone, and for the exercise of Federal management authority within that zone. While HR 200 provides for Federal preemption under certain circumstances, neither piece of legislation would diminish existing State fisheries management authority within the 3-mile territorial sea. This legislation would also provide a specific base for the SFFMP for the management of marine fisheries within the zone of extended jurisdiction. Both bills envision the establishment of seven Regional Marine Fisheries Councils. Council geographical configuration and composition varies between the two bills, both by representation and by numbers of members. The Councils will identify those fisheries in need of conservation and management as a manageable unit, such as a species, stock, geographical grouping, etc. The Senate bill also mentions the need for a Council to develop an area management plan with separate programs for each fishery within its area. Council plans and proposed regulations would be reviewed by the Secretary of Commerce for modification and implementation, subject to a public hearing. In the Senate version, an independent Fishery Management Review Board is proposed to hear appeals on regulations instituted by the Secretary. (See also W76-09329) (Auen-Wisconsin)

W76-13108

### 6F. Nonstructural Alternatives

#### FLOOD PLAIN INFORMATION, LOWER BUFFALO CREEK AND ITS TRIBUTARIES, NAHANTA AND BRANTLEY COUNTY, GEORGIA.

Army Engineer District, Savannah, Ga.  
For primary bibliographic entry see Field 4A. W76-13045

#### FLOOD PLAIN INFORMATION: SCIOTO AND OLENTANGY RIVERS, OHIO, CHILLICOTHE AREA SUMMARY REPORT.

Army Engineer District, Huntington, W. Va.  
For primary bibliographic entry see Field 4A. W76-13046

#### FLOOD PLAIN INFORMATION: VERDIGRIS, FALL AND ELK RIVERS, KANSAS.

Army Engineer District, Tulsa, Okla.  
For primary bibliographic entry see Field 4A. W76-13047

## Ecologic Impact Of Water Development—Group 6G

**FLOOD HAZARD ANALYSES: ROYAL RIVER AND CHANDLER BROOK, TOWN OF NORTH YARMOUTH, MAINE.**  
Soil Conservation Service, Washington, D.C.  
For primary bibliographic entry see Field 4A.  
W76-13053

**THE DEVELOPMENT CRITERIA OF THE PRELIMINARY COASTAL PLAN,**  
University of Southern California, Los Angeles.  
School of Public Administration.  
For primary bibliographic entry see Field 2L.  
W76-13092

**BACK BAY NATIONAL WILDLIFE REFUGE. SOME PARALLELS IN IMPLEMENTING THE COASTAL ZONE MANAGEMENT ACT,**  
Back Bay National Wildlife Refuge, Virginia Beach, Va.  
For primary bibliographic entry see Field 6E.  
W76-13105

**FREING THE BEACHES: IS IT POSSIBLE,**  
Bureau of Outdoor Recreation, Atlanta, Ga.  
Southeast Regional Office.  
For primary bibliographic entry see Field 6E.  
W76-13106

## 6G. Ecologic Impact Of Water Development

**OCCURRENCE, VIABILITY AND SIGNIFICANCE OF RESTING EGGS OF THE CALANOID COPEPOD LABIDOCERA AESTIVA,**  
Woods Hole Oceanographic Institution, Mass.  
G.D. Grice, and V. R. Gibson.  
Marine Biology, Vol. 31, p 335-337, 1975, 2 tab, 3 ref. NASA GA-43126.

Descriptors: Ecology, \*Overwintering sites, Sediments, \*Eggs, \*Copepods, Plankton.  
Identifiers: \*Labidocera aestiva.

Laboratory and field observations showed that eggs of *L. aestiva* remain viable for temperatures and time periods comparable to those encountered by eggs in the sediment. The existence of resting eggs in bottom sediment was demonstrated by the hatching of *L. aestiva* in incubated sediment collected in winter. Eggs kept for 6 months in jars hatched during May when water temperatures were 11 to 14 degrees C. It was concluded that resting eggs serve as a means to overwinter the species and as a mechanism to repopulate an area with the species. (Chilton-ORNL)  
W76-12737

**COMBINED EFFECTS ON THE ENVIRONMENT OF RADIOACTIVE, CHEMICAL AND THERMAL RELEASES FROM THE NUCLEAR INDUSTRY. (REPORT ON THE INTERNATIONAL SYMPOSIUM HELD IN STOCKHOLM JUNE 2-5, 1975),**  
International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety and Environmental Protection.  
For primary bibliographic entry see Field 5C.  
W76-12765

**TORTUGUERO BAY ENVIRONMENTAL STUDIES,**  
Puerto Rico Nuclear Center, Mayaguez.  
E. D. Wood, M. J. Youngbluth, M. E. Nutt, P. Yoshioka, and M. J. Canoy.  
Available from the National Technical Information Service, Springfield, VA 22161, as PRNC 181, \$8.00 in paper copy, \$3.00 in microfiche. Report PRNC-181, April 1975, 227 p, 89 ref, 32 fig, 22 tab, 4 append. AT(40-1)-1833.

Descriptors: \*Data collections, \*Sites, Powerplants, Geologic investigations, On-site investigations, Ecology, \*Puerto Rico, Physical properties, Chemical properties, Bays, Zooplankton, Invertebrates, Fish.  
Identifiers: \*Tortuguero Bay(PR).

Tortuguero Bay is one of seven coastal sites on which physical, chemical, and geological parameters have been studied. Ecological parameters of zooplankton, benthic invertebrates and fish communities, and plant associations were also studied. The purpose of the studies was to gather data which would be useful in the assessment of the desirability and practicability of locating power generating plants on one or more of the sites. (Chilton-ORNL)  
W76-12783

**SITE AND DESIGN TEMPERATURE RELATED ECONOMICS OF NUCLEAR POWER PLANTS WITH EVAPORATIVE AND NON-EVAPORATIVE COOLING TOWER SYSTEMS,**  
Gilbert Associates, Inc. Reading, Pa.  
J. F. Seabald.  
Report C00-2392-1, January 1976, 419 p, 37 fig, 137 tab, 4 ref. E(11-1) 2392.

Descriptors: \*Cost analysis, \*Design, \*Temperature, \*Sites, Economics, Nuclear powerplants, \*Cooling towers, \*Lake Michigan, Great Lakes, Evaporators.

The study was planned to include a wide range of plant design temperatures, develop cost elements suitable for the adjustment of differences in site, time, and location, and to develop cost sensitivity criteria such that the mass of cost data produced may be extended to include plants sited most anywhere in the United States. Two sites were selected for the study, each having characteristics which require special consideration. It was concluded that plants with evaporative cooling tower systems are economically preferable to equivalent plants using non-evaporative cooling tower systems. The cost data developed for plants with evaporative cooling systems showed that, for equivalent plants, the cost differences between natural draft and mechanical draft cooling tower systems were small, on the order of 0.5 to 0.8%. (Chilton-ORNL)  
W76-12784

**HABITAT EVALUATION PROCEDURES.**  
Fish and Wildlife Service, Washington, D.C., Div. of Ecological Services.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 254, \$4.00 in paper copy, \$3.00 in microfiche. July 1, 1976, 30 p.

Descriptors: \*Water resources development, \*On-site investigations, \*Carrying capacity, \*Habitats, \*Analytical techniques, \*Evaluation, Ecology, Economics, Projects, Costs, Benefits, \*Project planning, Annual equivalent costs, Annual equivalent benefits, \*Wildlife, Hunting, \*Fishing, Edge effect, \*Aquatic habitats, \*Terrestrial habitats, Wetlands, U.S. Water Resources Council, Wildlife management.  
Identifiers: Principles and Standards for Planning, National Environmental Policy Act(NEPA), Fish and Wildlife Coordination Act.

Habitat evaluation procedures were developed as a uniform, nationwide method for determining impacts on fish and wildlife and their habitat, arising from water and related land resource development projects. The procedures are divided into two main parts, one which measures the ability of the habitat to sustain fish and wildlife, and the other to measure the level of hunting and fishing which the habitat can sustain and still replenish itself from year to year. For each procedure, the quality of the habitat is measured either in ecological or economic terms, then the losses or gains estimated

to be sustained with the construction of a water or related land resource development project are calculated and annualized over the life of the project. Provision is made to compare several alternative plans for the area in term of habitat units for the ecological section, and in dollars for the economic section. An additional feature of the ecological section of the procedure involves estimating the increase in carrying capacity which can be attained with wildlife management. This value is then used to calculate the amount of habitat needed to compensate for wildlife losses attributable to the installation of the project. (Winters-FWS)  
W76-12845

**THE ENVIRONMENTAL IMPACT OF WATER CHLORINATION.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5C.  
W76-12876

**SOME ECOLOGICAL ASPECTS OF THE CABORA BASSA DAM,**  
Rhodes Univ., Grahamstown (South Africa). Inst for Freshwater Studies.  
B. R. Davies, A. Hall, and P. B. N. Jackson.  
Biological Conservation, Vol. 8, No. 3, p 189-201, 1975, 1 fig, 25 ref.

Descriptors: \*Environmental effects, \*Dams, \*Africa, \*Reservoirs, Electric power production, Productivity, Sediment transport, Deltas, Tropic, Aquatic weed control, Social aspects, Biocontrol, Insects, Floating plants, Vectors(Biological), Fish, Fisheries, Economic impact, Water pollution control, Recreation, Human population, Conservation, Wildlife management, Industries.  
Identifiers: \*Cabora Bassa Dam(Mozambique), Zambezi River(Mozambique), Paulina acuminata, Neochetina eichhorniae.

The lake resulting from the Cabora Bassa Dam on the Middle Zambezi in Mozambique, South Africa, is expected to eventually produce 3870 mw of electricity by September 1975. The potential of the region is enormous. At first the lake will have a large nutrient increase; initially this may be slowed by production of reducing substances such as hydrogen sulfide. The lake will tend towards oligotrophy. Invasion by aquatic macrophytes will be a problem. Mechanical and herbicidal removal is not feasible, but biological control is being considered. As nutrient levels stabilize, weed infestations should decrease. Floating weeds conserve major nutrients and provide shelter for fish fry. Draw-down for weed control would reduce marginal hydrophyte development. Fish will initially be species present in the river. Floating aquatic macrophytes and uncleared bush may make fishing difficult at first but a pelagic fishery shows promise. Possible ecological effects of the lake on wildlife in the area and downstream are discussed. Public health problems may arise; and the effects of resettlement of a 25,000 population are evaluated pro and con. Conservation measures are proposed with regard to recreational facilities, game reserves, and heavy industry. (Buchanan-Davidson-Wisconsin)  
W76-12945

**THE SOCIAL AND ECONOMIC IMPORTANCE OF THE CARONI SWAMP IN TRINIDAD AND TABAGO,**  
Michigan Univ., Ann Arbor. Dept. of Natural Resources.  
B. S. Ramdial.  
Available from the National Technical Information Service, Springfield, VA 22161 as COM 75-10846, \$9.00 in paper copy, \$3.00 in microfiche. PhD thesis, 1975. 266 p, 24 fig, 9 tab, 73 ref, 9 append.

Descriptors: \*Natural resources, \*Conservation, \*Resource allocation, Economic rent, Land use, Social values, Recreation, Tourism, Land use, Na-



## Field 6—WATER RESOURCES PLANNING

### Group 6G—Ecologic Impact Of Water Development

tional parks, \*Mangrove swamps, Estuaries, Fisheries, Statistical methods, Aesthetics, Employment, Benefits, Comprehensive planning, Management, Bird types, \*Swamps.  
Identifiers: \*Caroni Swamp(Trinidad/Tobago).

The threat of development and land use patterns to Trinidad and Tobago's outstanding Caroni Swamp engendered this social and economic study to determine its benefits. Non-priced recreational benefits, estimated by the travel-cost method, indicate that the Swamp resources are valued at \$1,038,500, with the addition of employment for 240 full-time and 105 part-time persons. The fin and shellfish harvest is valued at \$981,450 and based on a total annual return of \$2,020,020 calculates the present worth at \$4,000/acre. The opportunity cost is estimated at \$1,398,330 and the social cost at \$2,625,000, excluding multiplier effects and demand projections. The weakness of using the market system to guide public policy is discussed. Alternative measures for conflict situations and potential areas for development are described. In the absence of a competent central authority with clear, social, economic, and legal guidelines within which to operate, the intrinsic values of the Swamp are progressively deteriorating, conflict situations are growing and unfettered developmental pressures are mounting. It is recommended that this estuarine Swamp be declared a national park to preserve its employment opportunities, the large quantities of protein produced, the fish and wildlife supported, the educational opportunities available, the aesthetics, the coastal storm buffer, and its function in the abatement of inland flood waters. (Auen-Wisconsin)  
W76-12952

**ENVIRONMENT AND SOCIAL CLASS, EESG BIBLIOGRAPHY SERIES 15.**  
Bristol Univ. (England). Dept. of Economics.  
For primary bibliographic entry see Field 6B.  
W76-12962

**WISCONSIN ANNUAL REPORT 1975,**  
Upper Great Lakes Regional Commission, Madison, Wis.  
For primary bibliographic entry see Field 6B.  
W76-12964

**ENERGY DEVELOPMENT: THE ENVIRONMENTAL TRADEOFFS. VOLUME 3: RELATIVE ENVIRONMENTAL RANKING OF PROPOSED OFFSHORE CONTINENTAL SHELF AREAS ON THE BASIS OF IMPACTS OF OIL SPILLS.**  
Stanford Research Inst., Menlo Park, Calif.  
P. J. Kinney, P. D. Carpenter, M. D. Levine, and S. H. Traver.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-250 002, \$4.50 in paper copy, \$3.00 in microfiche. Prepared for the Office of Planning and Evaluation, U.S. Environmental Protection Agency, Washington, D.C., September 1975. 61 p, 14 fig, 10 tab, 40 ref.  
68-01-2469.

Descriptors: Aquatic habitats, Ecosystems, \*Trophic level, \*Aquatic environment, \*Oil spills, \*Oil pollution, \*Oil wells, Phytoplankton, Zooplankton, Fish, \*Marine animals, Birds, \*Atlantic Ocean, \*Continental Shelf, \*Benthos, \*Biota, Alaska.  
Identifiers: Benthic biotic, Shore-related biota, North Atlantic Ocean, \*South Atlantic Ocean, \*Mid-Atlantic Ocean, \*Santa Barbara Channel, \*South of Channel Islands, \*Gulf of Alaska, \*Bristol Bay(AK), \*Beaufort Sea(AK), \*Cook Inlet(AK), \*Kotzebue Sound(AK).

Ten offshore regions, North Atlantic, Mid-Atlantic, South Atlantic, Southern California including Santa Barbara Channel and South of Channel Islands, the Gulf of Alaska, Bristol Bay, Beaufort Sea, Cook Inlet, and Kotzebue Sound were stu-

died to determine the risks associated with oil drilling in the offshore continental shelf (OCS). Only the impact of oil spills were studied, and did not include impacts of man's activities in wilderness areas or the impact of changes, i.e., absorption of the sun's radiant energy due to oil on pack ice. The offshore regions were factored into ecological components based upon trophic levels and habitats. The components were phytoplankton, zooplankton, benthic biotic, shore-related biota, fish, marine mammals and birds. Biological and physical data were used to measure relative sensitivity of each ecological component to damage by oil; relative biological abundance; relative probabilities of major portions of the ecological component coming into contact with oil from a spill; and relative probabilities of a spill occurring. Each factor was evaluated on a 1 to 7 scale of increasing effect. Conclusions were that the least affected ecological areas would be the North Atlantic, Mid-Atlantic and Kotzebue Sound (AK); intermediate damage would occur in the South Atlantic, Beaufort Sea (AK), South of the Channel Islands and the Santa Barbara Channel; heavy damage is likely in Bristol Bay (AK), Cook Inlet (AK) and the Gulf of Alaska. (Gentry-NC)  
W76-13039

**A PROPOSED METHODOLOGY FOR ASSESSING ALTERNATIVE TECHNOLOGIES,**  
Cornell Univ., Ithaca, N. Y. Program on Science, Technology and Society.  
P. L. Bereano, J. Callen, W. B. Kellner, G. R. Olson, and B. H. Wengenroth.  
Technology Assessment, Vol. 1, No. 3, p. 179-190. 6 fig, 20 ref.

Descriptors: \*Methodology, \*Decision-making, \*Planning, \*Technology, \*Environmental effect, Environmental control, Probability, Alternate planning, \*Evaluation.  
Identifiers: Effects chain, Effects matrix, \*Alaska pipeline.

A matrix methodology for decision-making which could be used to assess technological developments is proposed and applied to the case of the Alaska pipeline. The proposed methodology draws on past work by J. C. Sorenson, Luna Leopold, I. D. J. Bross and two groups at Cornell University, the first 2 theories are analytical matrix methodologies and the third is an individual planning process. The matrices related actions which cause environmental impact with existing conditions and characteristics of the environment. Bross developed a prediction system wherein probabilities are assigned to various outcomes producing a numerical value which can be used to make decisions, and also involves a value system in which a value indicating the desirability of an outcome is assigned to each outcome. This report utilizes a matrix scheme which arrays the action alternatives on one axis and variables or parameters on the other axis. To identify appropriate parameters, and effects chain was developed as a visual technique to generate and display all parameters or effects associated with actions taken. The effects chain suggests causal relationships with parameters being the endpoints of the chain. An effects matrix lists intersections between parameters and techniques, thus serving as a helpful guide in the decision-making process. The next stage in developing a rational decision-making methodology would be to assign probabilities, utilities and importance to the outcomes described in the effects matrix. Public participation in decision-making may be enhanced by separating technical analysis from value weights and by forcing the disaggregation of complex systems. (Gentry-North Carolina)  
W76-13049

**DEVELOPMENT OF RESIDUALS MANAGEMENT STRATEGIES: AN EXECUTIVE SUMMARY,**  
Indiana Univ., Bloomington. School of Public and Environmental Affairs.

For primary bibliographic entry see Field 5G.  
W76-13054

**A PRELIMINARY ASSESSMENT OF THE ENVIRONMENTAL VULNERABILITY OF MACHIAS BAY, MAINE TO OIL SUPERTANKERS,**  
Massachusetts Inst. of Tech., Cambridge.  
S. F. Moore, R. L. Dwyer, and A. M. Katz.  
Available from the National Technical Information Service, Springfield, VA 22161 as COM-73-10564, \$6.75 in paper copy, \$3.00 in microfiche. Sea Grant Report No. MITSG-73-6, Index No. 73-306-Cwm, January 15, 1973. 171 p, 136 ref.

Descriptors: \*Maine, \*Oil pollution, \*Oil spills, \*Environmental effects, \*Resources development, \*Water pollution, Water resources, Transportation, Dispersion, Coasts, Beaches, Aquatic animals, Aquatic plants, Ports, Ecology.  
Identifiers: \*Outer Continental Shelf, \*Oil spill trajectories, Supertankers, Tanker terminals, Site survey, Environmental impact, \*Machias Bay(Maine).

The environmental vulnerability of Machias Bay, Maine to a proposed oil supertanker terminal was studied by means of a review and interpretation of the literature. A possible framework is proposed for assessing impacts of environmental changes. Processes considered are transport and dispersion, biological transfers and modifications, and biological effects. Separate consideration is given to a description of existing conditions along the eastern coast of Maine, the composition and characteristics of crude petroleum and petroleum products, the effects of oil on marine organisms, potential spill trajectories and behavior, and finally an assessment is made of the environmental vulnerability. (Sinha-OEIS)  
W76-13087

**THE POTENTIAL EFFECTS OF INCREASING OIL TANKER SIZE ON NARRAGANSETT BAY. AN ADVISORY REPORT TO THE COASTAL RESOURCES MANAGEMENT COUNCIL.**  
Rhode Island Statewide Planning Program, Providence.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-212 918, \$4.00 in paper copy, \$3.00 in microfiche. Technical Paper No. 24, July 1972. 26 p, 2 fig, 4 tab, 30 ref.

Descriptors: \*Rhode Island, \*Environmental effects, \*Water pollution effects, \*Resources development, \*Transportation, Leakage, Hazards, Damages, Accidents, Pollution, Water resources, Oil industry.  
Identifiers: \*Outer Continental Shelf, \*Narragansett Bay(RI), Oil tankers, Supertankers, Collisions.

The possible ramifications of the growth of the world tanker fleet, both in size and in numbers, and this growth's subsequent effect on Narragansett Bay is outlined. The report examines both ship-to-ship and ship-to-shore offloading and the possible pollution effects of these techniques. The three main causes of pollution - bilge pumping, transfer leakage and collisions - are also considered in terms of a future increase in tanker traffic on the Bay. (Sinha-OEIS)  
W76-13088

**POSSIBLE EFFECTS OF CONSTRUCTION AND OPERATION OF A SUPERTANKER TERMINAL ON THE MARINE ENVIRONMENT IN THE NEW YORK BIGHT,**  
State Univ. of New York at Stony Brook. Marine Sciences Research Center.  
J. L. McHugh, J. J. Ginter, W. E. Knapp, A. L. Tsao, and M. D. Greenfield.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-219 649, \$7.75 in paper copy, \$3.00 in microfiche. Sea Grant Report, November 1972. 223 p, 55 fig.

## RESOURCES DATA—Field 7

### Data Acquisition—Group 7B

Descriptors: \*Continental Shelf, \*Water pollution effects, \*Environmental effects, \*Oil spills, \*Oil pollution, \*Resources development, \*Waste disposal, New York, Bays, Oceans, Ports, Transportation, Hazards, Damages, Accidents, Dredging, Spoil banks.

Identifiers: \*Outer Continental Shelf, \*New York Bight, \*Tanker terminals, \*Supertankers, Deepwater ports, Coastal zone, Environmental impact.

An evaluation of the environmental impact of construction and operation of a supertanker terminal in the New York Bight area considers the effects of dredging and spoil disposition, vessel movements, chronic low-level oily discharges, and accidental spills. Three possible sites are studied and several construction alternatives are included. If chronic leakage or accidental spills can be contained or cleaned up quickly, then the environmental consequences of operating a deepwater terminal at either of the offshore sites probably would be acceptable. The risk to the coastal zone environment decreases with increasing distance from shore. Therefore it was recommended that if it is decided to construct a supertanker terminal in New York Bight it should be placed as far offshore as practical. (Sinha-OEIS)  
W76-13089

ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA, VOLUME I. Resource Planning Associates, Inc., Cambridge, Mass.  
For primary bibliographic entry see Field 5G.  
W76-13090

ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA. VOLUME II. METHODOLOGY APPENDICES. Resource Planning Associates, Cambridge, Mass.  
For primary bibliographic entry see Field 5G.  
W76-13091

THE COASTAL PLAINS REGIONAL COMMISSION—U.S. GEOLOGICAL SURVEY. AEROMAGNETIC-AERORADIOACTIVITY SURVEY. Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7B.  
W76-13099

## 7. RESOURCES DATA

### 7A. Network Design

METHODOLOGY FOR THE SELECTION AND APPLICATION OF PROBABILITY MODELS FOR THE SIMULATION OF DAILY RAINFALL AND RUNOFF. Purdue Univ., West Lafayette, Ind. School of Civil Engineering.  
M. I. Kavvas, and J. W. Delleur.  
Hydrological Sciences Bulletin, Vol. 21, No. 1, p. 99-111, March 1976. 11 fig, 3 tab, 18 ref. OWRT B-036-IND (8).

Descriptors: \*Rainfall, \*Runoff, \*Model studies, \*Methodology, Graphical analysis, Probability, Hydrology, Automation, Simulation analysis, Mathematical studies, Environment, Equations, Computers, Statistical methods, Statistics.  
Identifiers: \*Probability models, \*Climatological environment, Computer-oriented procedure, Statistical analysis, Hydrological point process, Homogenized data, Spectral density, Variance-time, Stochastic models.

A systematic, computer-oriented procedure was developed to avoid the problems of selecting the appropriate probability model for a particular climatological environment and of using it for operational purposes. The procedure avoided subjectivity

in the selection of the model and eased the labor in the successful selection and application of the stochastic model underlying the particular hydrological phenomenon. The methodology for the statistical analysis of series of events by Cox and Lewis (1966) was extended and applied to hydrology for the analysis of daily rainfall sequences. The hydrological point process had time trends and cyclicity. A procedure for the detection and calibration of these time trends and cyclicities was developed on the basis of which a homogenization program was produced. Statistical tests could be performed on the homogenized data. A method of statistical analysis utilizing the rate of occurrence function, the spectrum of counts, the variance-time of counts, the spectral density, the autocorrelation function, and the log-survivor function of the interarrival times was applied to the homogenized data to select a model that suited the behavior of these functions and passed the statistical tests. Several of these functions were tabulated for some point stochastic models. (Roberts-ISWS)  
W76-12994

### 7B. Data Acquisition

STUDIES ON THE POTENTIAL EVAPORATION OF LAWNS UNDER DIFFERENT CONDITIONS OF UNDERGROUND WATER: A COMPARISON OF CALCULATED VALUES WITH THE VALUES OF A LYSIMETER, (IN GERMAN). Technische Universitaet, Hanover (West Germany). Institut fuer Meteorologie und Klimatologie.  
For primary bibliographic entry see Field 2D.  
W76-12757

NEARSHORE CURRENTS AT POINT BEACH, WISCONSIN (1974-1975). Argonne National Lab., Ill.  
K. D. Saunders, L. Van Loon, C. Tome, and W. Harrison.  
Available from the National Technical Information Service, Springfield, VA 22161 as ANL/WR-76-1, \$9.00 in paper copy, \$3.00 in microfiche. Report ANL/WR-76-1, March 1976, 252 p, 42 fig, 10 tab, 23 ref, 3 append. W-31-109-Eng-38.

Descriptors: \*Data collections, \*Currents(Water), On-site investigations, Winds, Forecasting, Great Lakes, \*Wisconsin, \*Lake Michigan, \*Lake shores.

The goals of this research effort were to obtain an expanded data base for nearshore currents and winds in the vicinity of Point Beach, to determine the mechanisms governing the nearshore currents, to develop a predictive capability for determining the nearshore currents and to improve understanding of the processes of dispersion in the nearshore regime. Currents were monitored at stations 0.4, 1.1, and 3.8 km from shore. Graphs for the current and wind observation are presented which depict (1) U, V flow components versus time, (2) specific kinetic energy versus time, (3) flow speeds and directions versus time, (4) composite velocity histograms and associated U, V-component histograms, and (5) progressive vector diagrams. Optimal linear filtering techniques were used in prediction of nearshore currents. (Chilton-ORNL)  
W76-12758

TEMPERATURE RESPONSES OF A COC-LITHOPHORE, CRICOSPHAERA CARTERAE, MEASURED IN A SIMPLE AND INEXPENSIVE THERMAL-GRADIENT DEVICE, Duke Univ., Beaufort, N.C. Marine Lab.  
For primary bibliographic entry see Field 5A.  
W76-12764

A COMPARISON OF AERIAL INFRARED AND BOAT ORIENTED THERMAL PLUME MEASUREMENT TECHNIQUES, Argonne National Lab., Ill.  
For primary bibliographic entry see Field 5B.  
W76-12773

MEASUREMENT AND EVALUATION METHODS FOR THE DETERMINATION OF THE UNSATURATED HYDRAULIC CONDUCTIVITY OF SOILS IN SITU, (IN GERMAN).  
For primary bibliographic entry see Field 2G.  
W76-12799

QUANTITATIVE RELATIONSHIP BETWEEN REFLECTANCE AND TRANSPIRATION OF PHREATOPHYTES—GILA RIVER TEST SITE, Geological Survey, Tucson, Ariz.  
For primary bibliographic entry see Field 2D.  
W76-12802

INVESTIGATIONS CONCERNING MAPPING AND CLASSIFYING OF MARSH SOILS, (IN GERMAN). Kiel Univ. (West Germany). Geologisch-Palaeontologisches Institut und Museum.  
For primary bibliographic entry see Field 2G.  
W76-12814

REMOTE SENSING STUDY OF MAUMEE RIVER EFFECTS ON LAKE ERIE, National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.  
For primary bibliographic entry see Field 5A.  
W76-12819

A CONDUCTIVITY FLOW METER, Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.; and Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.  
P. H. John, F. A. Johnson, and P. Sutcliffe.  
Journal of Hydraulic Research, Vol. 14, No. 1, p. 37-44, 1976. 6 fig, 1 tab, 6 ref.

Descriptors: \*Flow measurement, \*Flow rates, \*Flow, \*Instrumentation, Conductivity, Equipment, Laboratory tests, Velocity, Salinity, Turbulence, Sediment control.  
Identifiers: \*Conductivity flow meter, Salt velocity method, Time of travel, Flow meters, Mean velocity.

The Conductivity Flow Meter (CFM) was shown to be a useful modification to existing salt velocity methods of flow measurement. This preliminary work clearly demonstrated the practicability of the CFM. Future work is aimed toward determining the range of application of the method and developing a set of operator guidelines for establishing geometric requirements of locating equipment in different channels. The figures demonstrated that the CFM is an acceptable alternative to the conventional current meter for measuring flow velocities. (Morris-ISWS)  
W76-12825

TECHNIQUES FOR OPTIMIZING A QUADRUPOLE GC/MS/COMPUTER SYSTEM, Environmental Research Lab., Athens, Ga.  
For primary bibliographic entry see Field 5A.  
W76-12870

RECOMMENDED DESIGN OF SAMPLE INTAKE SYSTEMS FOR AUTOMATIC INSTRUMENTATION, Environmental Monitoring and Support Lab., Cincinnati, Ohio.  
For primary bibliographic entry see Field 5A.  
W76-12871

## Field 7—RESOURCES DATA

### Group 7B—Data Acquisition

**INSTRUMENTATION AND AUTOMATION OF WASTEWATER COLLECTION AND TREATMENT SYSTEMS, (LITERATURE REVIEW),** Municipal Environmental Research Lab., Cincinnati, Ohio.  
For primary bibliographic entry see Field 5D.  
W76-12901

**CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES, (LITERATURE REVIEW),** Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.  
For primary bibliographic entry see Field 5A.  
W76-12902

**ULTRASONIC REMOVAL OF EPILITHIC ALGAE IN A BARCLAMP SAMPLER,** Ichthyological Associates, Inc., Berwick Pa.  
For primary bibliographic entry see Field 5A.  
W76-12939

**AN AUTOMATED ASSAY FOR THE DETERMINATION OF NITRATE REDUCTASE IN MARINE PHYTOPLANKTON,** Centre Universitaire de Luminy, Marseille (France). Laboratoire d'Océanographie.  
For primary bibliographic entry see Field 5C.  
W76-12940

**NEW DIVER-OPERATED BEDLOAD SAMPLER,** Georgia Inst. of Tech., Atlanta. Dept. of Geophysical Science.  
For primary bibliographic entry see Field 2J.  
W76-12972

**CLASSIFICATION AND ANALYSIS OF RIVER PROCESSES,**  
For primary bibliographic entry see Field 8B.  
W76-12973

**A GUIDE TO METHODS AND STANDARDS FOR THE MEASUREMENT OF WATER FLOW,** National Bureau of Standards, Washington, D.C., Inst. for Basic Standards.  
For primary bibliographic entry see Field 8B.  
W76-13000

**PORTABLE, ADJUSTABLE FLOW-MEASURING FLUME FOR SMALL CANALS,** Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 4A.  
W76-13007

**SHIPBOARD OIL-IN-WATER CONTENT MONITOR BASED ON SMALL ANGLE FORWARD LIGHT SCATTERING,** General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.  
For primary bibliographic entry see Field 5G.  
W76-13094

**THE COASTAL PLAINS REGIONAL COMMISSION—U.S. GEOLOGICAL SURVEY. AEROMAGNETIC-AERORADIOACTIVITY SURVEY,** Geological Survey, Reston, Va. I. Zietz.  
In: Coastal Plains Center for Marine Development Services 'Report of the Conference on Marine Resources of the Coastal Plains States', December 11-12, 1975, Savannah, Ga., p 5-8.

Descriptors: \*Coastal plains, \*Surveys, \*Oil, \*Metals, North Carolina, South Carolina, Georgia, Methodology, Geologic formations, \*Radioactivity techniques, \*Electromagnetic waves, \*Remote sensing.

Identifiers: \*Aeromagnetic survey, \*Aeroradioactivity survey, Ores, Minerals.

The Coastal Plains Regional Commission expended \$100,000 for surveys of North and South Carolina and Georgia to determine the potential of ore and oil deposits in this region. An aircraft, equipped with a magnetometer, flew continuous lines at a 500-ft altitude with a flight separation of one mile. A radioactivity survey was conducted jointly with the gamma measurements. Contours were compiled from the data and then digitized and transferred to magnetic tape for ready access. The radioactivity survey portion of the effort showed that there are three major monazite belts, paralleling the Piedmont and extending from Alabama to Virginia. Monazite is associated with titanium. The largest radioactivity anomalies were found along the Altamaha River. Chemical measurements of grab samples and two drillholes were used to determine the thickness of the deposit. The initial results of the investigations suggest that one deposit may be worth as much as \$1.5 billion. The total value of the combined six deposits in that vicinity are estimated to be as much as \$6 billion. The survey methods, as related to geology, are explained. (See also W76-09329) (Auen-Wisconsin)  
W76-13099

**THE CONTINUOUS ALUMINUM-FOIL HYDROMETEOR SAMPLER; DESIGN, OPERATION, DATA ANALYSIS PROCEDURES, AND OPERATING INSTRUCTIONS,** Air Force Cambridge Research Labs., Hanscom AFB, Mass.  
For primary bibliographic entry see Field 2B.  
W76-13173

**AN ERTS-1 STUDY OF COASTAL FEATURES ON THE NORTH CAROLINA COAST,** Coastal Engineering Research Center, Fort Belvoir, Va. G. H. Miller, and D. W. Berg.  
Available from the National Technical Information Service, Springfield, Va 22161 as ADA-022 336, \$4.00 in paper copy, \$3.00 in microfiche. Miscellaneous Report No. 76-2, January 1976. 41 p, 12 fig, 5 tab, 14 ref.

Descriptors: \*Remote sensing, \*Coasts, \*Estuaries, \*North Carolina, \*Atlantic Ocean, Rivers, Inlets (Waterways), Shallow water, Satellites (Artificial), Sand bars, Beaches, Suspended solids, Sediments, Coastal marshes, Oceans.  
Identifiers: \*ERTS.

Unenhanced imagery recorded by the multispectral scanner (MSS) of the NASA Earth Resources Technology Satellite (ERTS-1) was analyzed to determine how satellite imagery may be applied to specific coastal engineering problems. The study area was a segment of the North Carolina coast comprising Wrightsville Beach, Masonboro Inlet, Masonboro Beach, Carolina Beach Inlet, and Carolina Beach, which are areas of ongoing research by CERC. Analysis was supplemented by underflight imagery supplied by NASA and ground-truth data. Several significant coastal features were visible in the ERTS-1 imagery. Among those were plumes of suspended sediment emerging from inlets, changes in water coloration possibly due to effects of temperature change, inlet bars, and cape bars. In addition, morphological changes in selected coastal land features were determined by comparing ERTS-1 films obtained about 1 year apart. Limited water depth penetration was afforded by examining the lower MSS spectral bands. It was learned that maximum penetration can be expected to measure in tens of feet, depending on the physical characteristics of ocean water. Although inadequate for deeper penetration, this capability is adequate for exposure of backshore and nearshore underwater features. Image resolution capability is sufficient for observation of gross coastal features and processes but may not be adequate for viewing

smaller features such as wave patterns, morphological features on beaches, and many engineering structures. (Sims - ISWS)  
W76-13174

**SPECTRAL REFLECTANCE AND RADIANCE CHARACTERISTICS OF WATER POLLUTANTS,** Environmental Research Inst., of Michigan, Ann Arbor. Infrared and Optics Div.  
For primary bibliographic entry see Field 5A.  
W76-13176

**RESULTS OF SOIL MOISTURE FLIGHTS DURING APRIL 1974,** National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.  
For primary bibliographic entry see Field 2G.  
W76-13178

**AN ANALYSIS OF THE ERRORS ASSOCIATED WITH THE DETERMINATION OF ATMOSPHERIC TEMPERATURE FROM ATMOSPHERIC PRESSURE AND DENSITY DATA,** National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.  
For primary bibliographic entry see Field 2B.  
W76-13179

**BROADBAND SPECTRAL PHOTOGRAPHY OF THE JAMES RIVER,** National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.  
For primary bibliographic entry see Field 5A.  
W76-13180

**THE FEASIBILITY OF OIL-POLLUTION DETECTION AND MONITORING FROM SPACE. EXAMPLES USING ERTS-1 AND SKYLAB DATA,** Environmental Research Inst., of Michigan, Ann Arbor. Infrared and Optics Div.  
For primary bibliographic entry see Field 5A.  
W76-13181

**BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS,** Environmental Research Inst. of Michigan, Ann Arbor. Resources and Technology Div.  
For primary bibliographic entry see Field 2L.  
W76-13182

**BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS,** Environmental Research Inst. of Michigan, Ann Arbor. Resources and Technology Div.  
For primary bibliographic entry see Field 2L.  
W76-13183

**APPLICATIONS OF REMOTE SENSING TO ESTUARINE PROBLEMS,** Virginia Inst. of Marine Science, Gloucester Point.  
For primary bibliographic entry see Field 2L.  
W76-13184

**INTERDISCIPLINARY APPLICATIONS AND INTERPRETATION OF EREF DATA WITHIN THE SUSQUEHANNA RIVER BASIN,** Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources. G. J. McMurtry, and G. W. Petersen.  
Available from the National Technical Information Service, Springfield, VA 22161 as N75-27516, \$3.50 in paper copy, \$3.00 in microfiche. Quarterly Progress Report, December 1974-February 1975. 15 p. NASA NAS9-13406.

Descriptors: \*Remote sensing, \*Data processing, Resources, \*Pennsylvania, \*Resources develop



ment, Geology, Mining, Lead, Zinc, Fractures(Geologic), Groundwater, Photography, \*Computer programs, Acid mine water, Projects. Identifiers: \*ERTS, \*SKYLAB, Lineaments, Photointerpretation, \*Susquehanna River basin.

Current research activities of the SKYLAB EREP investigation were described. The following activities were mentioned: It has become evident that lineaments seen on SKYLAB and ERTS images are not equally well defined, and that the clarity of definition of a particular lineament is recorded somewhat differently by different interpreters. In an effort to determine the extent of these variations, a semiquantitative classification scheme has been devised. Lineament detections on SKYLAB and ERTS scenes are also being compared, with the objective of determining if the same features are seen on both sets of data and to what extent the precision of determination differs for the two data sets. Research has been continuing in the identification of ground evidence for lineaments and their usefulness in prospecting for lead-zinc deposits. In the study of the applications of lineaments to groundwater and geologic engineering problems, an additional area is being considered for analysis. Thermal anomalies from SKYLAB and ERTS scenes are being studied using both photo-interpretative and digital processing techniques. The SKYLAB data quality comparison study is progressing rapidly. The SUB-TRAN and TPINFO programs have been revised to process tapes in the SKYLAB S192 line-straightened and conical formats. Processing has begun on the newly received SKYLAB data tapes for three Pennsylvania areas. The study of acid mine drainage effects in Western Pennsylvania will be continued, using SKYLAB digital data. (Sims-USGS) W76-13188

## 7C. Evaluation, Processing and Publication

**HTPGBI: A COMPUTER PROGRAM FOR CALCULATING FROM EXPERIMENTAL DATA THE VARIATION IN HEAT TRANSFER COEFFICIENT ROUND A CYLINDRICAL SURFACE,** United Kingdom Atomic Energy Authority, Risley (England). Reactor Group. P. G. Barnett. TRG Report 2740(W), Sub-Ref: RPC/HT/P(75)5, 18 p, 1 fig, 4 ref, 2 append.

Descriptors: \*Computer programs, Mathematical models, \*Heat transfer.

In the calculations performed, the structure within the cylindrical surface is assumed to consist of a series of concentric annuli for any one of which the physical properties and volume generation of heat remain constant. These characteristics may vary, however, from one annulus to another. Heat conduction along the cylinder is assumed to be negligible, but adjustment for the localised longitudinal conduction effects associated with ribbed surfaces may be included. The program is written in FORTRAN and a version is available for the ICL 4-72 computer. (Chilton-ORN) W76-12687

**AN EVALUATION OF TWO HYDROGRAPH SEPARATION METHODS OF POTENTIAL USE IN REGIONAL WATER QUALITY ASSESSMENT,** Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5G. W76-12691

**GROUND-WATER BASIC DATA FOR DUNN COUNTY, NORTH DAKOTA.** Geological Survey, Bismarck, N. Dak. R. L. Klausning.

North Dakota County Ground-Water Studies 25--Part II, and North Dakota Geological Survey Bulletin 68--Part II, Bismarck, N. D. 1976. 501 p, 3 fig, 1 plate, 10 tab, 20 ref, 2 append.

Descriptors: \*Groundwater, \*Basic data collections, \*North Dakota, \*Water quality, \*Well data, Aquifer characteristics, Geology, Observation wells, Test wells, Water levels, Drillers logs, Springs, Groundwater resources, Chemical analysis, Water chemistry.

The ground-water investigation in Dunn County, N.D., was made cooperatively by the U.S. Geological Survey, North Dakota State Water Commission, North Dakota Geological Survey, and the Dunn County Water Management District. The results of the investigation will be published in three separate parts. Part (1) is an interpretive report describing the geology of the study area; part (2) is a compilation of the ground-water basic data; and part (3) is an interpretive report describing the ground water resources. Part (2) (this report) contains basic data for 1,216 wells and test holes and 134 springs. It includes 632 logs of test holes and wells, 408 chemical analyses of water samples, and water-level measurements in 140 observation wells. The geologic formations penetrated by drilling are Upper Cretaceous, Tertiary, and Quaternary in age. (Woodard-USGS) W76-12786

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,** Geological Survey, Denver, Colo. D. E. Trimble, and H. R. Fitch. For sale by USGS Reston, Va., 22092, price \$1.75. Miscellaneous Investigations Series Map I-857-A, 1974. 1 sheet, 1 map, 1 tab, 9 ref.

Descriptors: \*Fluvial sediments, \*Geologic mapping, \*Gravels, \*Rocks, \*Quarries, Mining, \*Colorado, Rock mechanics, Particle size, Aggregates, Flood plains, Glaciation. Identifiers: \*Colorado Springs-Castle Rock area(Colo).

High-quality gravel in the Front Range Urban Corridor is restricted largely to areas beneath flood plains of major streams and to low terraces along these streams. Rock suitable for processing into crushed-rock aggregate is plentiful in the older rocks of the mountains, in certain volcanic rocks of the foothills and plains, and in certain limestones, mainly in the Colorado Springs area. For many years, crushed limestone has been the chief source of concrete aggregate in the Colorado Springs area. Potential sources of gravel or of aggregate have been grouped into eight map units--three of gravel and five of crushed-rock aggregate. A potential source of gravel, as here defined and mapped contains 20 percent or more of granule- and pebblesize stones (smaller than 2.5 in. or 6.4 cm but retained on a No. 10 U.S. Standard sieve). The minimum gravel content was placed arbitrarily at 20 percent of the deposit because this was estimated to be the most likely economic limit under the most adverse foreseeable conditions. The map units are based on differences in physical characteristics, which, in turn, determine relative quality for different uses. (Woodard-USGS) W76-12787

**LAND-USE CLASSIFICATION MAP OF THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,** Geological Survey, Denver, Colo. L. B. Driscoll. For sale USGS, Reston, Va., 22092, price \$1.75. Miscellaneous Investigations Series Map I-857-B, 1975. 1 sheet, 1 map, 2 ref.

Descriptors: \*Land use, \*Land classification, \*Maps, \*Urbanization, \*Surface water, Land resources, Land management, Lakes, Reservoirs, \*Colorado. Identifiers: \*Front Range Urban Corridor(Colo), Colorado Springs-Castle Rock area(Colo).

The Front Range Urban Corridor of Colorado, from Fort Collins on the north through Fountain on the south, is an area of rapid population growth and expanding land development. This map provides for the Colorado Springs-Castle Rock area the first step toward compatible land uses in the future--a comprehensive picture of the distribution of different land classes and an implication about the proportions of various uses. If used with maps showing resources, soil types, geology, water availability, topography, demography, and other attributes, this land-classification map helps to set limitations on use of the land. Once the limitations are known, zoning can help assure land uses that are compatible with the natural environment--for example, the zoning of flood plains for greenbelt or recreational use. (Woodard-USGS) W76-12788

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,** Geological Survey, Denver, Colo. R. B. Colton, and H. R. Fitch. For sale by USGS, Reston Va., 22092, price \$1.75. Miscellaneous Investigations Series Map I-855-D, 1974. 1 sheet, 1 map, 1 tab, 39 ref.

Descriptors: \*Fluvial sediments, \*Geologic mapping, \*Gravels, \*Rocks, \*Quarries, Mining, \*Colorado, Rock mechanics, Particle size, Aggregates, Flood plains, Glaciation. Identifiers: \*Boulder-Fort Collins-Greeley area(Colo).

Deposits of high-quality gravel in the Boulder-Fort Collins-Greeley, Colo., area mostly under flood plains and terraces of major streams. Gravel and rock resources have been grouped into five map units; two are sources of gravel and three are sources of rock suitable for crushing. The map units are based not on quality judgments but on differences in physical characteristics which do determine quality which, in turn, determines suitability for different uses. Gravel deposits, as here defined and mapped, are inferred to contain at least 20-percent granule- and pebble-size stones: smaller than 2.5 inches (6.5 cm) but retained on a No. 10 (2 mm) U.S. Standard sieve. The minimum figure of 20 percent is estimated to be the lower limit at which gravel can be economically extracted from a deposit. Lower quality deposits have been worked in areas where haulage distances are short and a market for sand exists. (Woodard-USGS) W76-12789

**LAND-USE CLASSIFICATION MAP OF THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,** Geological Survey, Denver, Colo. L. B. Driscoll. For sale USGS, Reston, Va., 22092, price \$1.75. Miscellaneous Investigations Series Map I-855-B, 1974. 1 sheet, 1 map, 1 ref.

Descriptors: \*Land use, \*Land classification, \*Maps, \*Urbanization, \*Available water, Land resources, Watersheds(Basins), Surface waters, Land management, \*Colorado. Identifiers: \*Front Range Urban Corridor(Colo), Boulder-Fort Collins-Greeley area(Colo).

The Front Range Urban Corridor of Colorado is undergoing rapid urbanization and sprawl. Land-use mapping is the first type of information needed

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

to provide a comprehensive picture of the distribution of the uses of land and an implication about the balance of the uses. Combined with maps of resources, soil types, water availability, topography, demography, etc., the limitations of the land can be established. At this stage land-use zoning can create the kind of end product desired. This map, then, provides for the Boulder-Fort Collins-Greeley area the first very crucial step in moving toward the prevention of incompatible land uses in the future. The Front Range Urban Corridor extends from Fort Collins on the north to Fountain on the south, and from the foothills on the west to Greeley on the east. (Woodard-USGS) W76-12790

**MAP OF ROCK TYPES IN BEDROCK OF ALLEGHENY COUNTY, PENNSYLVANIA,**  
Geological Survey, Harrisburg, Pa.  
W. R. Kohl, and R. P. Briggs.  
Available from Branch of Distribution, USGS 1200 S. Eads St. Arlington, VA 22202, \$1.50. Miscellaneous Field Studies Map MF-685 A, 1975. 2 sheets, 2 maps, 2 fig, 2 tab, 36 ref.

Descriptors: Planning, Water resources development, \*Land development, \*Mineral industry, \*Maps, \*Pennsylvania, Geology, Rock properties, Bedrock.  
Identifiers: \*Allegheny County(Pa).

This map (Allegheny County, Pa.) is a tool useful in planning where a knowledge of characteristics of material to be moved, built upon, or otherwise utilized is necessary to adequately develop land, mineral, and water resources. Possible fields of application include land-use control, road construction, urban and industrial development water supply, and the search for nonmetallic mineral resources. On the map (scale 1:50,000 or 1 inch equals just over 4,000 feet), the types of rock likely to be found at or near the surface throughout the county are indicated by letter symbols keyed to the map explanation and two accompanying tables. Table 1 estimates the general engineering characteristics of the rock units, and table 2 describes the most common rock types in greater detail. Geological terms that may be unfamiliar are explained in the glossary. (Woodard-USGS) W76-12791

**ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1974 TO SPRING 1975.**  
Geological Survey, Tucson, Ariz.  
H. M. Babcock.  
Water-Resources Investigations 76-59 (open-file report), May 1976. 2 sheets, 1 map.

Descriptors: \*Groundwater resources, \*Water fluctuations, \*Pumping, \*Irrigation, \*Arizona, \*Maps, Aquifers, Water wells, Water yield, Projections, Data collections, Water utilization, Water levels.

The withdrawal of ground water was slightly more than 5.7 million acre-feet in Arizona in 1974—the largest amount pumped in any year since the beginning of record. About 4.9 million acre-feet of ground water was used for the irrigation of crops in 1974. The Salt River Valley and the lower Santa Cruz basin are the largest agricultural areas in the State. For 1970-74, ground-water withdrawal in the two areas was about 8.3 and 4.6 million acre-feet, respectively, and, in general, water levels are declining. Other areas in which ground-water withdrawals have caused large water-level declines are the Willcox, San Simon, upper Santa Cruz, Avra Valley, Gila Bend, Harquahala Plains, and McMullen Valley areas. Two small scale maps of Arizona show (1) pumpage of ground water by areas and (2) the status of the ground-water inventory in the State. The map of the State at a scale of 1:500,000 shows potential well production, depth to water selected wells in spring 1975, and change in water level in selected wells from 1970 to 1975.

The brief text that accompanies the maps summarizes the current ground-water conditions in the State. (Woodard-USGS) W76-12792

**HYDROLOGIC UNIT MAP—1974, STATE OF MONTANA.**  
Geological Survey, Reston, Va.  
For sale by USGS, Reston, Va., 22092, \$3.00. Hydrologic Unit Map, 1976. 2 sheets, 2 maps.

Descriptors: \*Maps, \*Hydrology, \*Montana, Water resources, Data collections, Planning, Hydrologic systems, Regions, Land resources. Identifiers: \*Hydrologic unit maps(Mont), Hydrologic boundaries, Subregions, Accounting units, Cataloging units.

This map and accompanying table show Hydrologic Units in Montana that are basically hydrographic in nature. The Cataloging Units shown will supplement the Cataloging Units previously used by the U.S. Geological Survey in its Catalog of Information on Water Data (1966-72). The Regions, Subregions and Accounting Units are aggregates of the Cataloging Units. The Regions and Subregions are currently (1974) used by the U.S. Water Resources Council for comprehensive planning, including the National Assessment, and as a standard geographical framework for more detailed water and related land-resources planning. The Accounting Units are those currently (1974) in use by the U.S. Geological Survey for managing the National Water Data Network. (Woodard-USGS) W76-12793

**MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED BY THE U. S. ENVIRONMENTAL DATA SERVICE, AND BY THE U. S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.**  
Geological Survey, Denver, Colo.  
E. R. Hampton.  
For sale by USGS, Reston, Va., 22092, \$1.25. Miscellaneous Investigations Series Map I-856-C, 1975. 1 sheet, 1 map, 41 ref.

Descriptors: \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, \*Maps, Data collections, Sites, Bibliographies, Publications, Streamflow, Sediment transport, Water wells, \*Colorado.  
Identifiers: \*Denver area(Colo).

This map shows types and locations of the hydrologic data published as of January 1974 for the Greater Denver Area by the U.S. Environmental Data Service and by the U.S. Geological Survey and cooperating agencies. The sources of the data are given in both the discussion and the reference. Climatological data include records of precipitation, temperature, and evaporation. Surface-water data include continuous record of stage and discharge of streams; crest-stage and low-flow discharge of streams; chemical quality of streams, lakes, and reservoirs; sediment load of streams; and stage of reservoirs. Locations of 46 surface-water data sites are shown on the map. Ground-water data sites plotted on the map represent 218 wells where water levels have been measured periodically for 4 or more years or monthly for at least 1 year, and 366 wells from which water samples have been analyzed for dissolved-chemical constituents. (Woodard-USGS) W76-12794

**MAP SHOWING LAKES IN THE GREATER DENVER AREA FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
T. W. Danielson.  
For sale by USGS, Reston, Va., 22092, \$1.25. Miscellaneous Investigations Series Map I-856-B, 1975. 1 sheet, 1 map, 1 tab.

Descriptors: \*Lakes, \*Lake morphometry, \*Maps, \*Limnology, \*Water quality, \*Lake morphology, Lake shores, Chemical analysis, Biological properties, Light penetration, Secchi disks, Algae, \*Colorado.  
Identifiers: \*Denver area(Colo).

This map report of the Greater Denver, Colo., area includes data for 49 lakes that have surface areas greater than 10 hectares (about 25 acres). These lakes have a total combined area of 3,686 hectares and a total shoreline of 185 kilometers (115 miles). The largest are Barr Lake, 708 hectares; Standley Lake, 492 hectares; and Chatfield Lake, 465 hectares. Barr Lake also has the longest shoreline, 15.6 kilometers, and Gross Reservoir has the next longest, 14.9 kilometers. In addition, 113 lakes range in size from 2 to 10 hectares. These have a total area of 526 hectares and a total shoreline of 110 kilometers. Most of the lakes contain water of good quality. Most of the lakes contained water that was alkaline. Slightly acidic water occurred only in Marshall Lake (pH = 5.5). The highest pH (10.3) was measured in water from Reservoir E on the Rocky Mountain Arsenal grounds; Kendrick Reservoir was nearly as high with a pH of 10.0. Values of pH of 8.5 or less occurred in 29 of the 49 lakes measured. Transparency, as measured by a Secchi disk, was less than 1.2 meters in 17 of the 51 lakes in which it was measured. It ranged from 1.2 to 5.5 meters in the other 34 lakes. Transparency was 5.0 meters in Gross Reservoir, 5.5 meters in McLellan Reservoir, and 0.5 meter or less in 8 of the lakes measured. (Woodard-USGS) W76-12795

**MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
D. E. Trimble, and H. R. Fitch.  
For sale by USGS, Reston, Va., 22092, price \$1.75. Miscellaneous Investigations Series Map I-856-A, 1974. 1 sheet, 1 map, 1 tab, 33 ref.

Descriptors: \*Fluvial sediments, \*Geologic mapping, \*Gravels, \*Rocks, \*Quarries, Mining, \*Colorado, Rock mechanics, Particle size, Aggregates, Flood plains, Glaciation.  
Identifiers: \*Denver area(Colo).

High-quality gravel in the Front Range Urban Corridor, Colo., is restricted largely to areas beneath flood plains of major streams and to low terraces along these streams. Rock suitable for processing into crushed-rock aggregate is plentiful in the older rocks of the foothills and plains. Potential sources of gravel or of aggregate have been grouped into seven map units—three of gravel and four of crushed-rock aggregate. A potential source of gravel, as here defined and mapped, contains 20 percent of more of granule- and pebble-size stones (smaller than 2.5 in. or 6.4 cm, but retained on a No. 10 U.S. Standard sieve). The minimum gravel content was placed arbitrarily at 20 percent of the deposit because this is the most likely economic limit under the most adverse foreseeable conditions. The map units are based on differences in physical characteristics, which, in turn, determine relative quality for different uses. (Woodard-USGS) W76-12796

**LAKES IN THE COLORADO SPRINGS—CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,**  
Geological Survey, Denver, Colo.  
D. B. Adams.  
For sale USGS, Reston, Va., 22092, price \$1.75. Geological Survey Miscellaneous Investigations Series Map I-857-E, 1976. 1 sheet, 1 map, 4 tab, 4 ref.

**Descriptors:** \*Lakes, \*Water quality, \*Urbanization, \*Environmental effects, \*Maps, Water utilization, Water demand, Lake morphology, Chemical analysis, Physical properties, Limnology, Biological properties, Water temperature, \*Colorado.  
**Identifiers:** \*Lake inventory, \*Colorado Springs-Castle Rock area(Colo).

The many lakes in Colorado's semiarid Front Range Urban Corridor are highly valued by the area's residents. In the past they were used primarily to store water for irrigation and domestic uses. Today, rapid suburban development in the Front Range Urban Corridor is accompanied by a shift in the principal use of many lakes to recreation and centers of real estate development. These same lakes are threatened with a general deterioration of chemical and biological quality caused by changing land and lake use in the area. This report presents the results of an inventory of the lakes in the southern one-third of the Colorado Front Range Urban Corridor. Data on physical size are included for most lakes of 2 hectares (20,000 square meters, about 5 acres) or greater, and water-quality data are provided for most lakes larger than 5 hectares (about 12 acres). (Woodard-USGS)  
W76-12797

**WATER FOR INDUSTRIAL AND AGRICULTURAL DEVELOPMENT IN COAHOMA, DE SOTO, PANOLA, QUITMAN, TATE, AND TUNICA COUNTIES, MISSISSIPPI.**  
Geological Survey, Jackson, Miss.  
For primary bibliographic entry see Field 3E.  
W76-12798

**FLUCTUATIONS OF GROUND-WATER LEVELS IN LEE COUNTY, FLORIDA, IN 1974.**  
Geological Survey, Tallahassee, Fla.  
For primary bibliographic entry see Field 4B.  
W76-12801

**HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS METROPOLITAN AREA, 1974.**  
Geological Survey, Austin, Tex.  
B. B. Hampton.  
Open-file report, June 1976. 182 p, 4 fig, 3 tab, 7 ref.

**Descriptors:** \*Hydrologic data, \*Urban hydrology, \*Urban runoff, \*Streamflow, \*Urbanization, Data collections, Flood frequency, Gaging stations, Storm runoff, Rainfall-runoff relationships, Hydrographs, Mass curves, \*Texas.  
**Identifiers:** \*Dallas metropolitan area(Tex).

This report presents the compilation and analysis of hydrologic data collected in urban or partly urban drainage basins in the Dallas, Texas, metropolitan area during the 1974 water year. The objectives of the Dallas area program, which began in 1961, are: (1) To determine, on the basis of historical data and hydrologic analyses, the magnitude, frequency, and areal extent of flooding. (2) To document and define floods of greater than ordinary magnitude. (3) To determine the effect of urban development on flood peaks and volume. The studies involve the collection of precipitation, runoff, and flood-elevation data in 10 drainage basins within the city and 3 drainage basins outside the city in Dallas County. Two of the 10 drainage basins in Dallas have headwaters in rural areas outside the city limits, but the largest part of each drainage basin is within the city. The drainage basins within the city include Joes Creek, Bachman Branch, Turtle Creek, White Rock Creek, Elam Creek, Coombs Creek, Cedar Creek, Fiveville Creek, Newton Creek, and Whites Branch. The three drainage basins outside the city of Dallas are Tennyille Creek, Duck Creek, and South Mesquite Creek. (Woodard-USGS)  
W76-12804

**A PLAN FOR STUDY OF WATER AND ITS RELATION TO ECONOMIC DEVELOPMENT IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING.**  
Geological Survey, Cheyenne, Wyo.  
For primary bibliographic entry see Field 6D.  
W76-12805

**DATA ON SELECTED LAKES IN WASHINGTON, PART 4.**  
Geological Survey, Tucson, Ariz.  
J. B. McConnell, G. C. Bortleson, and J. K. Innes.  
Washington Department of Ecology, Olympia, Water-Supply Bulletin 42, Part 4, 1976. 141 p, 1 fig, 32 ref.

**Descriptors:** \*Lakes, \*Basic data collections, \*Water quality, \*Lake morphology, \*Washington, Baseline studies, Chemical properties, Physical properties, Biological properties, Bathymetry, Maps, Aerial photography, Water temperature.

This report, the fourth in a series, contains chemical, biological, and physical data collected from 31 lakes in Washington during 1973. For each lake there is a description of the physical setting, a general discussion of water quality, a bathymetric map, and an aerial photograph. The basic data include depth profiles of dissolved-oxygen concentration and temperature. Each lake was sampled four times, from winter to late summer. In general, the study consists of a data-collection program designed to (1) document the present water quality and the overall status of the lakes, and (2) provide basic data pertaining to the physical, cultural, and water-quality characteristics of lakes in order to establish a base of reference that will allow future periodic reappraisals of lake conditions and evaluation of changes. (Woodard-USGS)  
W76-12808

**ORGANICS IN DRINKING WATER. PART II. MASS SPECTRAL IDENTIFICATION DATA.**  
Ames Lab., Iowa.  
For primary bibliographic entry see Field 5A.  
W76-12812

**PUBLIC GROUNDWATER SUPPLIES IN LAKE COUNTY.**  
Illinois State Water Survey, Urbana.  
For primary bibliographic entry see Field 4B.  
W76-12824

**COMPARISON OF REQUIRED RESERVOIR STORAGE COMPUTED BY THE THOMAS-FIERING MODEL AND THE 'KARLSRUHE MODEL' TYPE A AND B.**  
Karlsruhe Univ. (West Germany). Institut fuer Wasserbau III.  
For primary bibliographic entry see Field 4A.  
W76-12832

**COMPUTER HALTS FLOODING COMPLAINTS.**  
Watermation, Inc., Saint Paul, Minn.  
For primary bibliographic entry see Field 5D.  
W76-12905

**DATA ANALYSIS AND SYSTEM MODELLING IN URBAN CATCHMENT AREAS (IN THE NEW TOWN OF LELYSTAD, THE NETHERLANDS).**  
IJsselmeerpolders Development Authority, Lelystad (Netherlands). Scientific Div.  
For primary bibliographic entry see Field 2A.  
W76-12981

**SURFACE WATER TEMPERATURES AT SHORE STATIONS, UNITED STATES WEST COAST, 1973.**  
Scripps Institution of Oceanography, La Jolla, Calif.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-009 937, \$3.50 in paper copy, \$3.00 in microfiche. Report SIO Ref 75-8, April 1975. 27 p.

**Descriptors:** \*On-site data collections, \*Sea water, \*Water temperature, \*Coasts, \*Washington, \*Oregon, \*California, Data collections, Salinity, Monthly, Average, \*Pacific coast region, Pacific Ocean.

Sea surface temperature and salinity data observed during 1973 along the west coast of North America from the strait of Juan de Fuca, Washington to La Jolla, California were presented. The data consisted of monthly means, ranges, and standard deviations based on daily observations. (Humphreys-ISWS)  
W76-12995

**WICHITA FALLS IMIS PROJECT. WATER UTILITY PROCESSING SYSTEM APPLICATION EVALUATION REPORT.**  
Kansas Univ., Lawrence. Inst. for Social and Environmental Studies.  
For primary bibliographic entry see Field 3D.  
W76-13040

**FLOOD PLAIN INFORMATION, LOWER BUFFALO CREEK AND ITS TRIBUTARIES, NAHUNTA AND BRANTLEY COUNTIES, GEORGIA.**  
Army Engineer District, Savannah, Ga.  
For primary bibliographic entry see Field 4A.  
W76-13045

**FLOOD PLAIN INFORMATION: SCIOTO AND OLENTANGY RIVERS, OHIO, CHILLICOTHE AREA SUMMARY REPORT.**  
Army Engineer District, Huntington, W. Va.  
For primary bibliographic entry see Field 4A.  
W76-13046

**FLOOD PLAIN INFORMATION: VERDIGRIS, FALL AND ELK RIVERS, KANSAS.**  
Army Engineer District, Tulsa, Okla.  
For primary bibliographic entry see Field 4A.  
W76-13047

**FLOOD HAZARD ANALYSES: ROYAL RIVER AND CHANDLER BROOK, TOWN OF NORTH YARMOUTH, MAINE.**  
Soil Conservation Service, Washington, D.C.  
For primary bibliographic entry see Field 4A.  
W76-13053

**AVAILABILITY OF GROUND WATER IN THE MIDDLE CONNECTICUT RIVER BASIN, WEST-CENTRAL NEW HAMPSHIRE.**  
Geological Survey, Concord, N. H.  
J. E. Cotton.  
Water-Resources Investigations 76-18 (open-file report), 1976. 1 sheet, 4 ref.

**Descriptors:** \*Groundwater availability, \*Water quality, \*Groundwater resources, Aquifers, \*New Hampshire, Maps, Hydrologic data, Water wells, Springs.  
**Identifiers:** \*Middle Connecticut River basin(NH).

This map provides a preliminary assessment of the availability of ground water in the New Hampshire part of the middle Connecticut River basin. It is a generalization of several hydrogeologic factors and provides a guideline for ground-water exploration which is useful in water- and land-use planning. The best aquifers in the basin are deposits of stratified sand and gravel of Pleistocene age. Large aquifers of this type occur in the Ammonoosuc River valley (a tributary of the Connecticut River) and in valleys of tributaries to the Ammonoosuc River. Smaller aquifers occur



## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

in the Connecticut River valley and in the valleys of other tributaries. Ground water is generally of good chemical quality. Iron and manganese in concentrations greater than the recommended limits for drinking water suggested by the U. S. Public Health Service are not uncommon. (Woodard-USGS) W76-13062

#### COMPILING BATHYMETRY FOR FLOW SIMULATION MODELS.

Geological Survey, Reston, Va.  
R. W. Schaffranek, and R. A. Baltzer.  
In: Symposium on Modeling Techniques, Volume II; 2nd Annual Symposium of the Waterways, Harbors and Coastal Engineering Division of ASCE (2 Vol.), San Francisco, California, September 3-5, 1975. American Society of Civil Engineers, New York, p 1329-1346, 1975. 7 fig, 5 ref.

Descriptors: \*Bathymetry, \*Model studies, \*Flow characteristics, \*Data processing, Methodology, Data collections, Deep water, Contours, Computers, Monitoring, Navigation.

A highly modular, automated bathymetric data collection and processing system has been developed by the U. S. Geological Survey in support of its modeling effort. This system permits rapid, economical collection and processing of the detailed bathymetric data required to properly schematize the bottom configuration of river, estuary, lake, reservoir and (or) coastal embayment models. The system is composed of electronic equipment used to acquire the data and a closely integrated comprehensive set of computer programs to process the data. Hardware components include a precision radio ranging unit, a depth sounder, a precision clock, a digital plotter, a digital tape recorder, and a mini-computer that controls and monitors the operation of the individual components. The computer software system is designed to process edit, verify, triangulate, collate and otherwise transform the bathymetric data into numerical arrays or graphical products in support of the modeling effort. (See also W76-10415) (Woodard-USGS) W76-13064

#### WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1975.

Geological Survey, Columbia, S. C.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 855, \$7.75 in paper copy, \$3.00 in microfiche. Water-Data Report SC-75-1, 1976. 210 p, 4 fig, 4 tab, 25 ref.

Descriptors: \*South Carolina, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling sites, Water levels, Water analysis, Basic data collections.

Water resources data for the 1975 water year for South Carolina consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 56 gaging stations; stage only records for 4 gaging stations; stage and contents for 11 lakes and reservoirs; water quality for 19 gaging stations and 4 ungaged stations; and water levels for 26 observation wells. Also included are 25 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (Woodard-USGS) W76-13066

#### WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1975.

Geological Survey, Raleigh, N.C.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 860, \$11.75 in paper copy, \$3.00 in microfiche. Water-Data Report NC-75-1, 1976. 426 p, 3 fig, 4 tab, 30 ref.

Descriptors: \*North Carolina, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling sites, Water levels, Water analysis, Basic data collections.

Water resources data for the 1975 water year for North Carolina consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 149 gaging stations; stage and contents for 23 lakes and reservoirs; water quality for 45 gaging stations and 42 miscellaneous sites; and water levels for 52 observation wells. Also included are 16 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in North Carolina. (Woodard-USGS) W76-13067

#### WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1975.

Geological Survey, Huron, S. Dak.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 861, \$9.25 in paper copy, \$3.00 in microfiche. Water-Data Report SD-75-1, 1976. 279 p, 6 fig, 4 tab, 30 ref.

Descriptors: \*South Dakota, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling sites, Water levels, Water analysis, Basic data collections.

Water resources data for the 1975 water year for South Dakota consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 95 gaging stations; stage for 10 lakes and reservoirs; water quality for 26 gaging stations, 10 partial-record flow stations, one lake, and 105 wells; and water levels for 16 observation wells. Also included are 105 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (Woodard-USGS) W76-13073

#### WATER RESOURCES DATA FOR IOWA, WATER YEAR 1975.

Geological Survey, Iowa City, Iowa.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 858, \$9.75 in paper copy, \$3.00 in microfiche. Water-Data Report IA-75-1, 1976. 305 p, 4 fig, 4 tab, 3 ref.

Descriptors: \*Iowa, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling sites, Water levels, Water analysis, Basic data collections.

Water resources data for the 1975 water year for Iowa consists of records of stage, discharge, and

water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 112 gaging stations; stage or contents for 8 lakes and reservoirs; water quality for 41 gaging stations of which 24 have periodic or miscellaneous sampling frequencies, 302 partial-record flow stations; and water levels for 47 observation wells. Also included are data for 128 crest-stage partial-record stations and 321 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Iowa. (Woodard-USGS) W76-13074

#### WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1975.

Geological Survey, Louisville, Ky.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 853, \$10.00 in paper copy, \$3.00 in microfiche. Water-Data Report KY-75-1, 1976. 334 p, 5 fig, 4 tab, 32 ref.

Descriptors: \*Kentucky, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Sampling sites, Water levels, Water analysis, Basic data collections.

Water resources data for the 1975 water year for Kentucky consists of records of stage, discharge, and water quality of streams; stage and contents of lakes; and water levels and water quality of wells and springs. This report contains discharge records for 124 gaging stations; stage and contents for 13 lakes; water quality for 55 gaging stations, 15 water-quality stations, 36 miscellaneous stations, and 30 wells and springs; and water levels for 41 observation wells. Also included are data for 73 crest-stage partial-record stations and 125 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (Woodard-USGS) W76-13075

#### SURFACE WATER SUPPLY OF THE UNITED STATES, 1966-70: PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS—VOLUME 2. UPPER MISSISSIPPI RIVER BASIN ABOVE KEOKUK, IOWA.

Geological Survey, Reston, Va.  
Available from the Supt. of Documents, GPO, Washington, DC 20402, Price \$6.30. Water-Supply Paper 2114, 1976. 785 p, 1 fig.

Descriptors: \*Hydrologic data, \*Surface waters, \*Streamflow, \*Lakes, \*River basins, Illinois, Iowa, Minnesota, Wisconsin, Runoff, Discharge(Water), Gaging stations, Flow measurement, Average flow, Reservoir stages, \*Mississippi River.

Identifiers: \*Hudson Bay basin, \*Upper Mississippi River basin, Maximum discharges, Minimum discharges.

This is one of 37 reports presenting records of stage and discharge of streams, and of stage and contents of lakes and reservoirs in the United States during the 1966-70 water years; it contains the records for gaging stations and partial-record stations in the upper Mississippi River basin above Keokuk, Iowa. This report is one of the second series of water-supply papers to be published on a 5-year basis. The first series covered the 5-year

period October 1, 1960, to September 30, 1965. This series covers the period October 1, 1965, to September 30, 1970. The daily table for stream-gaging stations gives the mean discharge for each day and is followed by monthly and yearly summaries of total, average, maximum, and minimum discharges. (Woodard-USGS)  
W76-13076

**INDEX TO NATIONAL TOPOGRAPHIC MAPS: 1:250,000-SCALE SERIES.**  
Geological Survey, Reston, Va.  
National Topographic Maps, November 1975. 1 sheet.

Descriptors: \*Indexing, \*Maps, \*Topographic mapping, \*Drainage area, \*United States, Planning, Water resources development, Construction, Land development, Highways, Pipelines, Geological surveys.  
Identifiers: \*Drainage basins, \*State maps, Quadrangle maps.

The 1:250,000-scale maps named on this index are part of the National Topographic Map Series published by the Geological Survey, which includes several series of quadrangle and other topographic maps of the United States, Puerto Rico, Virgin Islands, American Samoa, and Guam. These multicolored maps are drawn on a transverse Mercator projection and are generally published in quadrangle units of 1 degree of latitude by 2 degrees of longitude. The paper size is about 22 by 34 inches. The contour interval ranges from 50 feet in relatively flat areas to 200 feet in mountainous regions. Supplementary contours at one-half the basic contour interval are sometimes added in areas of low relief. One inch on the map represents about 4 miles on the ground. Because of the limitations of this scale, detail is somewhat generalized and some small features are omitted. The maps are useful in planning projects extending over large areas, such as highway locations, oil and gas pipeline routes, transmission lines, selection of radio and television station sites, geologic investigations, studies of drainage basins, and for other purposes. (Woodard-USGS)  
W76-13077

**FINITE-DIFFERENCE MODEL FOR AQUIFER SIMULATION IN TWO DIMENSIONS WITH RESULTS OF NUMERICAL EXPERIMENTS,**  
Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 2F.  
W76-13085

**AN OVERVIEW OF THE PRECIPITATION PROCESSING SYSTEM AT THE SOUTHWEST WATERSHED RESEARCH CENTER,**  
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.  
D. L. Chery, Jr., and R. S. Kagan.  
U.S. Department of Agriculture, ARS, Western Region, p 48-59, June 1976. 2 fig, 2 tab.

Descriptors: \*Precipitation(Atmospheric), \*Impact(Rainfall), \*Arizona, \*New Mexico, \*Data processing, Rain gages, Data storage and retrieval, Watershed management, Water yield, Water utilization.  
Identifiers: \*Southwest Watershed Research Center(Ariz), Modularization.

Described are various records kept in the Southwest Watershed Research Center's (SWWRC) precipitation data file and the processing scheme for information. The collection and processing of precipitation data is part of a comprehensive program to study the water yield of semiarid rangeland watersheds in the Southwest with respect to conservation measures and forage production; to determine the optimum utilization of such yield for local and downstream needs; and to collect data for aid planning and designing measures to control flash flood and sediment damage.

Besides precipitation data, records are also made of stream flow, vegetation and soil surveys, infiltration tests, and meteorological, geologic, geomorphic and soil moisture data. Rainfall charts collected at the Arizona and New Mexico locations are sent to the SWWRC for coding, digitizing and final processing. The system's flow of data is charted and types of field instrumentation described. Classification and other processing steps are outlined, along with a system of data quality determination. (Jahns-Arizona)  
W76-13132

**INTERDISCIPLINARY APPLICATIONS AND INTERPRETATION OF EREP DATA WITHIN THE SUSQUEHANNA RIVER BASIN,**  
Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.  
For primary bibliographic entry see Field 7B.  
W76-13188

## 8. ENGINEERING WORKS

### 8A. Structures

**PLAN OF WORK, RED RIVER BASIN ABOVE DENISON DAM.**  
Soil Conservation Service, Temple, Tex.  
For primary bibliographic entry see Field 4A.  
W76-12816

**VIBRATIONS OF EARTH DAMS.**  
Akademiya Nauk SSSR, Moscow. Institut Fiziki Zemli.  
For primary bibliographic entry see Field 8D.  
W76-12823

**DRAINAGE MAINTENANCE PROGRAMS IN OHIO COUNTIES,**  
Ohio State Univ., Columbus. Cooperative Extension Service.  
For primary bibliographic entry see Field 4A.  
W76-13009

**IDENTIFICATION AND NATURE OF DISPERSIVE SOILS,**  
Soil Conservation Service, Lincoln, Nebr.  
For primary bibliographic entry see Field 8D.  
W76-13170

### 8B. Hydraulics

**TURBULENT CHARACTERISTICS OF DRAG-REDUCING FLOWS,**  
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.  
C. V. Alonso, W. H. Klaus, and K. F. Wylie.  
Journal of Hydraulic Research, Vol. 14, No. 2, p 103-113, 1976. 6 fig, 27 ref.

Descriptors: \*Turbulent flow, \*Hydraulic transportation, \*Polymers, \*Aqueous solutions, \*Energy dissipation, Equations, Laboratory tests, Eddies, Pipe flow, Drag, Hydraulics.  
Identifiers: \*Interactive layer model, \*Spectral densities, Dilute polymer solutions.

The reduction of frictional losses in turbulent flows of dilute polymer solutions is of particular interest to the civil engineers concerned with the hydraulic transport of solids and dredge spoil for considerable distances overland. The drag reduction is believed to result from altering of the turbulent-eddy production in dilute polymer solutions so as to make the process less dissipative. The turbulence characteristics of polymer flows were investigated in the laboratory from measurements in water and in a polyethylene oxide aqueous solution, using hot-film anemometry. Mean velocities, turbulence intensities, energy spectra, and energy-

dissipation rates were measured in a turbulent smooth-pipe flow. The results of the mean flow measurements indicated that the velocity profiles follow the interactive layer model proposed earlier. The spectral data for water and polymer solutions exhibited similar inertial and dissipation subranges, although near the wall the polymer flows had a more extended inertial subrange. The addition of polymer decreased the rate of energy dissipation. The drag reducing property of the polymer additives was found to be effective only in the inner-wall region of bounded turbulent flows. (Singh-ISWS)  
W76-12826

**SWIRLING CIRCULAR TURBULENT WALL JETS,**  
University Coll. of Engineering, Burla (India).  
B. S. Pani, and N. Rajaratnam.  
Journal of Hydraulic Research, Vol. 14, No. 2, p 145-154, 1976. 13 fig, 14 ref.

Descriptors: \*Velocity, \*Jets, \*Walls, \*Shear stress, Turbulent flow, Hydraulics, Fluid mechanics, Model studies, Graphical analysis, Mathematical studies.  
Identifiers: \*Wall jets, Circular wall jets, \*Swirl, Swirling number, Velocity profiles, Circular jets, Bed shear stress.

An experimental study of swirling circular wall jets, with the swirl number equal to 0.141 and 0.265, showed that the axial velocity profiles in the center plane are similar and are well described by the curve of the simple plane wall jet. The axial velocity distribution in the transverse direction (parallel to the wall) was also similar (in the neighborhood of the wall) and was well described by the Goertler-type solution for the circular jet. The velocity scale decreased inversely with the axial distance whereas the length scales grew linearly with the axial distance. The effect of swirl was to make the velocity scale decay faster and it also made the jet spread more rapidly in the transverse direction. The swirl also reduced the centerline bed shear stress effectively. The distribution of the bed shear stress in the transverse direction was found to be similar. (Lee-ISWS)  
W76-12828

**MAJOR JUNCTION STRUCTURE VERIFIED BY MODELING,**  
Santa Barbara County Water Agency, Los Angeles, Calif.  
C. H. Lawrance, and M. W. Dowd.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY4, Proceedings Paper 12066, p 499-513, April 1976. 5 fig, 1 tab, 1 ref, 2 append.

Descriptors: \*Colorado River, \*Model studies, \*Hydraulic design, \*Design, \*Hydraulic models, \*Hydraulic structures, Costs, Flow, Pipelines, Gates, Hydraulic gates, Water supply, Water hammer, Valves, Equations.  
Identifiers: Tower configuration.

Two hydraulic models of alternative configurations of a junction structure involving two large water supply conduits were tested for efficiencies in mixing of the respective supply waters and for other hydraulic characteristics under a broad range of operational conditions. An open tower configuration having two concentric, vertical tanks and an enclosed piping cross configuration were both model tested. The tower configuration was found to be more efficient in mixing and acceptable in hydraulic characteristics, provided certain baffling was provided. The engineering evaluation also favored the tower configuration, which was subsequently constructed and found to operate generally as predicted by the modeling. (Morris-ISWS)  
W76-12840

## Field 8—ENGINEERING WORKS

### Group 8B—Hydraulics

**EXPERIMENTAL STUDY OF TURBULENT STRATIFIED SHEARING FLOW.**  
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.  
For primary bibliographic entry see Field 2L.  
W76-12841

**COASTAL DISPERSION OF POLLUTANTS.**  
Polish Academy of Sciences, Gdansk. Inst. of Hydraulic Research.  
For primary bibliographic entry see Field 5B.  
W76-12843

**WAVE-INDUCED MASS TRANSPORT IN WATER WAVES.**  
Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. Marine Studies.  
For primary bibliographic entry see Field 2H.  
W76-12844

**ENTRAINMENT AND DRAG FORCES OF DEFLECTED JETS.**  
Stone and Webster Engineering Corp., Boston, Mass. Environmental Engineering Div.  
D. T. L. Chan, J. T. Lin, and J. F. Kennedy.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY5, Proceedings Paper 12141, p 615-635, May 1976. 13 fig, 1 tab, 20 ref, 1 append. ONR N00014-68-A-0196-0004.

Descriptors: \*Jets, \*Hydraulics, \*Drag, \*Turbulent flow, \*Mixing, Laboratory tests, Pressure, Mathematical studies, Momentum transfer, Measurement, Entrainment, Equations, Mathematics.  
Identifiers: \*Deflected jets, Wind tunnel experiments, Cross-flow velocity, Jet trajectories.

Experiments were carried out on a round turbulent jet with a Reynolds number of 200,000 discharged perpendicularly into crossflows in a wind tunnel. The jet-to-crossflow velocity ratio ranged from about two to nine. The drag force resulting from the pressure distribution around the jet was found to make a significant contribution to the momentum uptake by the jet only in the region just above the jet origin, while the momentum of the entrained fluid makes its principal contribution over the reach, where the jet has become fully developed, but is not yet extensively deflected. Integral-type analyses were developed, by solving the integrated equations of mass and momentum conservation and the kinematic relation, to predict jet behavior in the nearfield, curvilinear, and far field regions. The entrainment velocity was related to two components of the jet velocity relative to the crossflow velocity. The drag force on the jet was considered only in the near-field, jet dominated region. Values of the entrainment and drag coefficients were inferred from the experimental data analyzed within the framework of the analytical model. (Singh-ISWS)  
W76-12969

**SELECTIVE WITHDRAWAL CRITERIA OF STRATIFIED FLUIDS.**  
Catholic Univ. of America, Washington, D. C. Dept. of Civil and Mechanical Engineering.  
T. W. Kao.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY6, Proceedings Paper 12188, p 717-729, June 1976. 6 fig, 1 tab, 18 ref, 2 append. NSF ENG 75-09347, ONR N0014-67-A-0377-0027, NR 062-498.

Descriptors: \*Density stratification, \*Discharge(Water), \*Stratification, Withdrawal, Hydraulics, Equations, Water quality, Reservoirs, Columns, Flow, Laboratory tests, Channels.  
Identifiers: \*Selective level releases, Criteria, Columnar disturbances, Topographical effects.

A general criterion for the presence or absence of selective withdrawal in a fluid or arbitrary stratification due to a line sink in a channel was presented. Several examples were given. The criterion was based on whether the speed of upstream propagating columnar disturbances is greater or less than the initial uniform velocity induced by the line sink. The result was then extended to topographical influence in the form of a lateral contraction of the channel walls. Experiments were conducted and they verified the conclusions for the lateral contraction. The use of lateral contractions to insure uniform flow in a stratified channel or reservoir was indicated. (Lee-ISWS)  
W76-12970

**COMPARISON OF SINGLE-POINT INJECTIONS IN PIPE FLOW.**  
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.  
A. M. Ger, and E. R. Holley.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY6, Proceedings Paper 12172, p 731-746, June 1976. 8 fig, 1 tab, 12 ref, 2 append.

Descriptors: \*Pipe flow, \*Tracers, Waste disposal, Instrumentation, Hydraulics, Industrial wastes, Jets, Equations, Mixing, Flow, Mathematical studies, Concrete additives.  
Identifiers: Point source, Single-point injections.

For applications such as using tracer techniques for discharge measurements in pipes or using a segment of a pipe as a mixing chamber, it is desirable to know the rate at which the concentration of injected material becomes mixed within the pipe cross section. The distance required to achieve a given degree of mixing depends on the injection system and the pipe flow characteristics. The mixing for three single-point injection systems was compared. The three systems were center line source, a wall source, and a jet at the wall issuing perpendicularly to the pipe flow. It was learned that a center line source can provide the most rapid mixing, but it is extremely difficult to maintain the symmetry necessary to achieve the rapid mixing; the wall source gives the slowest mixing; the mixing for jet injection depends on M, the ratio of the jet momentum to the pipe momentum. For a jet injection, there was an optimum M which gave the most rapid mixing for given flow characteristics, and this mixing was more rapid than either a wall source or most practically achievable center line sources. (Lee-ISWS)  
W76-12971

**CLASSIFICATION AND ANALYSIS OF RIVER PROCESSES.**  
R. Kellerhals, M. Church, and D. I. Bray.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY7, Proceedings Paper 12232, p 813-829, July 1976. 5 fig, 2 tab, 42 ref, 1 append.

Descriptors: \*Canada, \*Geomorphology, \*Channel morphology, \*Aerial photography, \*Flood plains, Hydraulics, \*Alluvial channels, Slopes, River systems, Classification, Braiding, Sediment, Meanders, Land forming.  
Identifiers: \*Photointerpretation, \*Alberta, Channel sinuosity.

Aerial photographs and brief field visits are frequently the only data sources for the preliminary design of river engineering works in remote or undeveloped areas. Even if short-term field data are available, they may be misleading because of the nonuniform rates at which river processes take place. The major active processes are, however, reflected in the river morphology so that correct classification and interpretation of channel, floodplain, and terrace features on maps and photographs can, to some degree, overcome a lack of long-term data. Rivers present a wide spectrum of

intermediate forms between the familiar classic braided and meandering types. This reflects a similarly wide spectrum of flow distribution, bed material size, sediment transport, and channel stability. Existing river classification schemes were reviewed, and a modified system was proposed to take account of the gradual transition between classical types. (Lardner-ISWS)  
W76-12973

**SHAPE AND SIZE OF ALLUVIAL CANALS.**  
Central Water and Power Research Station, Poona (India).  
S. V. Chitale.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY7, Proceedings Paper 12260, p 1003-1011, July 1976. 3 fig, 6 tab, 6 ref, 2 append.

Descriptors: \*Canal design, \*Canals, \*Alluvial channels, \*Dimensions, Hydraulics, Channel flow, Slopes, Streambeds, Correlation analysis, Equations, Mathematical studies, Statistics.  
Identifiers: \*Lacey formulas.

Deviations of observed canal dimensions from those given by Lacey formulas were investigated. In the process, shape and size characteristics of canal section were found to give relationships between the basic parameters, P, R, and S, which suggests that one of these could be selected, but the other two then acquired unique values satisfying the two equations regarding shape and size. Design formulas were evolved on the basis of these equations, many of which were found to yield more accuracy than with the Lacey formulas. (Lardner-ISWS)  
W76-12975

**FLOODWATER RETARDING STRUCTURE YIELD IMPACT.**  
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.  
For primary bibliographic entry see Field 4A.  
W76-12978

**A GUIDE TO METHODS AND STANDARDS FOR THE MEASUREMENT OF WATER FLOW.**  
National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.  
G. Kuln, and P. R. Compton.  
Available from the National Technical Information Service, Springfield, VA 22161 as COM-75-10683, \$5.00 in paper copy, \$3.00 in microfiche. Special Publication 421, May 1975. 97 p, 50 fig, 9 tab, 57 ref, 2 append.

Descriptors: \*Flow measurement, \*Flowmeters, \*Standards, \*Instrumentation, Pipe flow, Open channels, Open channel flow, Water, Weirs, Venturi meters, Flow rates, Flow, Current meters, Water measurement, Stream gages, Orifices, Hydraulics, Nozzles, Flumes, Equations.  
Identifiers: Parshall flumes, Elbow meters, Magnetic flowmeters, Acoustic flowmeters, H-flumes.

Selected information sources on methods and standards for making measurements of water and wastewater flow in the field were listed and described. Both closed conduit and free surface flows were treated, but emphasis was on open channel flow measurements needed in water resource engineering and in water pollution control. Instruments and methods covered include weirs, flumes, current meters (and velocity traverse methods), dilution techniques, pipe flow instruments, acoustic meters and others. In addition to summarizing the basic properties of each instrument or method and referring users to the best available sources of detailed information on performance and field application, potential sources of error were described and quantified where possible. The information presented is intended to assist measurement supervisors and their personnel engaged in establishing and operating



ing water and wastewater flow measurement stations in the field. It is geared to technical people who are not necessarily fluid mechanics specialists. (Humphreys-ISWS)  
W76-13000

#### ON HAMMERS,

Wellfield Services, Johannesburg (South Africa).  
For primary bibliographic entry see Field 8C.  
W76-13026

#### EFFICIENCY-A WORLD OF FANTASY,

Australian Ground-water consultants Ltd., Sandton, Transvaal (South Africa).  
For primary bibliographic entry see Field 8G.  
W76-13028

#### 'STIFF FOAM' DRILLING,

Wellfield Service, Johannesburg (South Africa).  
Div. of Drilling Technical Services Ltd.  
R. McCallum.  
Journal of the Groundwater Association of South and South West Africa, Vol. 1, No. 2, p 4, 12, July, 1975.

Descriptors: \*Drilling fluids, \*Rotary drilling, \*Foaming, Slurries, Boreholes, Water wells.  
Identifiers: \*Stiff foam, Lost circulation, Annular velocity, Borehole erosion, Air requirements.

Rotary drilling with a stiff foam is an economical means of drilling where problems have been encountered with air or mud drilling techniques. The advantages of using a stiff foam are due to the low density fluid which prevents lost circulation, annular wall erosion, and good hole cleaning capabilities when drilling in sticky clays and gravels. The stiff foam concept is based on 'thickening' the air so the borehole can be cleaned at a low annular velocity (200-250 feet per minute). Due to the lower annular velocity a substantial reduction in air requirements and a lower annulus pressure results. Stiff foam is made up with a concentrated foaming agent added to a high yield bentonite slurry. Normally 7 to 10 gallons of slurry is injected for each cubic foot of hole cut. Two variations of the injection method are used with stiff foam; the continuous injection and slug injection. Control of the system is based on surface injection pressure, drill string torque, and condition and regularity of foam in the discharge pipe. Stiff foam was originally developed for conventional rotary air drilling; however, this technique also adds greatly to the capability of down-the-hole hammer drilling. (Heiss-NWWA)  
W76-13029

#### DOWN-THE-HOLE INSURANCE,

Plummer and McDannald Co., Galena, Ohio.  
For primary bibliographic entry see Field 8G.  
W76-13032

#### ENGINEERED IRRIGATION WELLS,

For primary bibliographic entry see Field 4B.  
W76-13033

#### WHATEVER HAPPENED TO THE HYDRAULIC RAM,

For primary bibliographic entry see Field 8C.  
W76-13034

#### EFFICIENT AQUIFER DEVELOPMENT IS NECESSARY TO EXPLOIT FULL YIELD POTENTIAL,

Wellfield Services, Johannesburg (South Africa).  
Div. of Drilling Technical Services Ltd.  
A. P. Sobott.  
Journal of the Groundwater Association of South and West Africa, Vol. 1, No. 2, p 5-6, July, 1975. 1 fig.

Descriptors: \*Drilling, \*Boreholes, \*Drilling equipment, \*Porosity, Aquifers, Drawdown, Water wells, Groundwater, Water yield improvement.

Identifiers: \*Well development, \*Filtrate invasion, \*Filtercake, \*Aquifer damage, Drilling technique.

Inadequate aquifer development in production water well boreholes result in high well losses and consequent increased drawdown. A large number of wells which have been abandoned as dry or low yielding, in fact only require efficient aquifer development. Cable tool rig operators commonly continue drilling for long periods without baling the hole clean. This causes a large volume of fine tailings to be forced into the porous formation during the pounding action of the drill bit. Porosity is thereby reduced to a fraction of the original value. Likewise, circulation rotary drilling techniques circulate fine sand in the fluid which frequently invade porous sand aquifers. This is caused by the jetting action at the bit and the head pressure placed on the aquifer during fluid circulation. The down hole hammer method of drilling is less likely to cause aquifer damage due to the ability to flush 'fines' from the formation during drilling. With the use of reverse circulation equipment, aquifer invasion and damage can be kept to a minimum, particularly when drilling in stable hard rock environments where the circulation system can be 'starved'. The water drawn from the aquifer will flush out the cuttings. Each of these methods may be superior to the other in specific drilling situations. While damage to the aquifer is unavoidable in most cases, all reasonable care must be exercised to preclude this by proper selection of the drilling method and development technique. (Heiss-NWWA)  
W76-13035

#### WELL CUTTINGS ANALYSIS IN GROUND-WATER RESOURCES EVALUATION,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
For primary bibliographic entry see Field 8G.  
W76-13036

#### HOW TO DRILL A USABLE HOLE - PART 2, DESIGNING THE BOTTOMHOLE ASSEMBLY,

Drilco, Houston, Tex. Technical Services.  
G. E. Wilson.  
World Oil, Vol 183, No 4, p 47-51, September, 1976. 17 fig, 1 tab.

Descriptors: \*Rotary drilling, \*Drilling equipment, \*Boreholes, \*Borehole geophysics, Rock mechanics.

Identifiers: \*Bottomhole assemblies, \*Borehole deviations, \*Packed hole theory, Pendulum theory, Drill collar design, Drill bit weighting.

Techniques are available to reduce or eliminate drill hole deviation. A popular method is to use the packed hole assembly. This method utilizes a series of stabilizers in the hole already drilled to guide the bit straight ahead. The bottom hole assembly is designed with the necessary stiffness and wall contact tools to force the bit to drill in the general direction of the hole already drilled. Design considerations given to packed hole assemblies are: tool assembly length, drill collar stiffness, clearance between the hole wall and stabilizers, and bottomhole assembly wall support. Proper design of a packed hole assembly requires that crooked hole tendencies and degree of formations drillability be considered. Crooked hole tendencies may be classed as either mild, medium or severe. Formation firmness is rated as soft to medium hard, and medium hard to hard, which is further divided into abrasive or non-abrasive. The stabilizing tools used in packed hole assemblies are of three basic types which include the rotating blade, the nonrotating rubber sleeve, the rolling cutter reamer and variations of the three. When it becomes necessary for total hole deviation to be reduced, the pendulum technique must be em-

ployed. In this technique, the pendulum length collars are swung below the regular packed hole assembly. By reducing the bit weight, bending characteristics of the drill string are changed and the hole will tend to be straighter. Recently it has been found that this is not always the best procedure because reducing the bit weight reduces penetration rate and frequently causes doglegs. (See also W76-11915) (Heiss-NWWA)  
W76-13038

#### WATER QUALITY MODEL OF A SALT-WEDGE ESTUARY,

Geological Survey, Tacoma, Wash.  
For primary bibliographic entry see Field 5B.  
W76-13063

#### COMPILING BATHYMETRY FOR FLOW SIMULATION MODELS,

Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 7C.  
W76-13064

#### A SIMPLIFIED SLOPE-AREA METHOD FOR ESTIMATING FLOOD DISCHARGES IN NATURAL CHANNELS,

Geological Survey, Reston, Va.  
For primary bibliographic entry see Field 4A.  
W76-13083

#### AN ERTS-1 STUDY OF COASTAL FEATURES ON THE NORTH CAROLINA COAST,

Coastal Engineering Research Center, Fort Belvoir, Va.  
For primary bibliographic entry see Field 7B.  
W76-13174

#### TECHNIQUES IN EVALUATING SUITABILITY OF BORROW MATERIAL FOR BEACH NOURISHMENT,

Coastal Engineering Research Center, Fort Belvoir, Va.  
W. R. James.  
Available from the National Technical Information Service, Springfield, Va 22161 as AD/A-019 936, \$5.00 in paper copy, \$3.00 in microfiche. Report No. TM-60, December 1975. 81 p, 10 fig, 2 tab, 12 ref, 3 append.

Descriptors: \*Beaches, \*Model studies, \*Erosion, \*Beach erosion, Mathematical models, Shore protection, Coastal engineering, Seashores, Erosion control, Materials, Sands, Coasts, Shores.  
Identifiers: \*Borrow materials, Beach nourishment.

Selection of borrow material for use in beach restoration and periodic nourishment requires analysis of the textural differences between the potential borrow and native beach materials. Three quantitative techniques proposed for such analysis were reviewed and compared, and guidelines were suggested for use in planning and designing projects requiring beach nourishment. The techniques were of two types. One type was based on the assumption that sorting processes will selectively remove borrow material from the various size classes until a 'stable grain-size distribution' (gsd) is obtained and the placed fill is stabilized. The gsd of the native material was used to predict the character of the stable gsd. Methods of this type lead to calculation of a 'fill factor,' an estimate of volume of borrow material required to produce a unit volume of stable beach material. Another type of technique was based on the assumption that no material is absolutely stable, but that erosion rates depend in part on the gsd of the material exposed to existing coastal processes. Prediction of erosion rates associated with a given borrow material was based on observation of erosion rates and textural properties associated with native materials. This method resulted in a 'renourishment factor' for determining volumetric

## Field 8—ENGINEERING WORKS

### Group 8B—Hydraulics

requirements for periodic nourishment. Practical application of any of the methods is dependent on the engineering design, the historical behavior of the beach in the project area, and the techniques of handling the borrow material before and during its placement. (Sims-ISWS)  
W76-13175

### 8C. Hydraulic Machinery

**WATERWORKS OF THERMAL ELECTRIC POWER STATIONS,**  
V. N. Pokrovskii.  
Available from the National Technical Information Service, Springfield, VA 22161 as JPRS 66221, \$4.00 in paper copy, \$3.00 in microfiche. Excerpt from the book: *Vodostabzheniye Teplovyykh Elektrostantsiy*. Moscow, 1958, 21 p, 11 fig, 3 tab.

Descriptors: Engineering, \*Electrical engineering, Engineering structures, Electric powerplants, Design, Design criteria, Cooling towers, \*Water supply, \*Water works.  
Identifiers: USSR.

A review is presented concerning questions of water supply to thermal electric power stations. The report here is concerned with graduating towers of two types: spray and dripwise. The paper is designed for water supply system design engineers and builders and thermal electric power station operating personnel and can be used as an aid by students in higher institutions of learning. (Chilton-ORNL)  
W76-12811

**SWIRLING CIRCULAR TURBULENT WALL JETS,**  
University Coll. of Engineering, Burla (India).  
For primary bibliographic entry see Field 8B.  
W76-12828

**MAJOR JUNCTION STRUCTURE VERIFIED BY MODELING,**  
Santa Barbara County Water Agency, Los Angeles, Calif.  
For primary bibliographic entry see Field 8B.  
W76-12840

**SEDIMENT FLUSHING AFTER DREDGING IN TIDAL BAYS,**  
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics.  
K. Cederwall, and T. Svensson.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 102, No. HY7, Proceedings Paper 12229, p 935-953, July 1976. 10 fig, 3 tab, 16 ref, 2 appendix.

Descriptors: \*Mathematical models, \*Dispersion, \*Dredging, \*Sedimentation, Environmental engineering, Environmental effects, Estuaries, Hydraulics, Water pollution, Suspended load, Suspended solids, Bottom sampling.  
Identifiers: \*Sediment flushing, \*One-dimensional dispersion, Dredging area, Dispersion model, Upper sediment layer, Resedimentation, Tidal flushing.

A one-dimensional dispersion model for tidal flushing of suspended material was formulated. It was suggested that this model could be used to predict the escape of suspended material from an estuarine dredging area out into the adjacent waters. The dispersion model included a sedimentation function to reproduce the effect of resedimentation. Calibration of the model was carried out in a restoration area by means of in-situ tracer tests and salinity measurements to establish the dispersive properties of the water body. The settling characteristics of the upper sediment layer were established by sedimentation analysis of bot-

tom samples from the dredging area, divided into an organic (polluted) top layer and underlying inorganic sediment. (Roberts-ISWS)  
W76-12974

**ON HAMMERS,**  
Wellfield Services, Johannesburg (South Africa).  
P. G. Herbert.  
Journal of the Groundwater Association of South and South West Africa, Vol. 1, No. 3, p 14-15, December, 1975.

Descriptors: \*Rotary drilling, \*Drilling equipment, Drilling fluids, Fractures(Geology), Water wells, Boreholes, Clays.  
Identifiers: \*Airhammer bits, Bit weight, Bit life, Water injection, Foaming detergents, Drill string maintenance.

Constant attention to the rig while drilling and expertise at the controls will prevent a stuck hammer when using high pressure, air, rotary drilling techniques in fractured rock zones. Verticality and straightness of the borehole can be maintained by the use of large and long drill collars directly behind the hammer. Too little attention to the weight over the hammer can result in lost bottom off bits, poor bit life, broken bit shanks and even broken pistons. All of these result in lost time and money to the operator. Injection of water with a biodegradable foaming detergent at all times will prevent blowing dust, increase cooling for the hammer, aid in the returning the cuttings and help prevent lost circulation. Drilling through clays with a hammer bit is simplified by water injection, medium weight on the bit, and a relatively high speed (approximately 60 r.p.m.) rotation rate. Too much weight on the bit when drilling clays will result in 'plugging off' of the bit. Constant stripping and cleaning of air hammer bits is not necessary if care is taken in maintaining, protecting and using the bit. Maintenance includes the injection of soluble lubricating oil at all times during operation in sufficient quantities to line the inside of the drillrods. The rods should be kept clean with their threads protected at all times when not in use. Careful operation of the rig and common sense care of the downhole apparatus will give long equipment life and successful drilling while using hammer bits. (Heiss-NWWA)  
W76-13026

**WHATEVER HAPPENED TO THE HYDRAULIC RAM.**  
Ground Water Age, Vol. 10, No. 12, p 46, 48, 80-81, August, 1976. 4 fig.

Descriptors: \*Hydraulic machinery, \*Hydraulic systems, \*Pumps, Hydraulic gradient, Heat pumps.  
Identifiers: \*Hydraulic rams.

The hydraulic ram has been used for more than 100 years for the pumping of water without the aid of any energy except the power generated by flowing water. Water is directed from a source, a stream, lake, spring or artesian well to the hydraulic ram by way of a drive pipe. When a sufficient volume of water has flowed through the waste valve to build enough pressure to close the outlet. When this occurs, the water is forced through the check valve and into the air chamber. The moving water compresses the air enclosed in the compartment so that it causes a piston-like action which closes the check valve and forces water up the delivery pipe to a storage tank for use. The device can be used to power small hydraulic electric generators as well as heat and cool buildings when used in conjunction with water-to-air heat pumps. The biggest disadvantages of the ram are: (1) the users access to a substantial amount of flowing water, (2) A sufficient drop or head difference between the water source and ram, (3) the length of intake or drive pipe from the water source to the ram, (4) the distance the water must be delivered, both horizontally and vertically. However, if con-

ditions are right, the hydraulic ram is still the most pollution free and least expensive method of getting water to run uphill. (Heiss-NWWA)  
W76-13034

**EFFICIENT AQUIFER DEVELOPMENT IS NECESSARY TO EXPLOIT FULL YIELD POTENTIAL,**  
Wellfield Services, Johannesburg (South Africa).  
Div. of Drilling Technical Services Ltd.  
For primary bibliographic entry see Field 8B.  
W76-13035

**HOW TO DRILL A USABLE HOLE - PART 2, DESIGNING THE BOTTOMHOLE ASSEMBLY,**  
Drilco, Houston, Tex. Technical Services.  
For primary bibliographic entry see Field 8B.  
W76-13038

**WATER ACTION POWERED PUMP,**  
L. E. Hooper, III.  
U. S. Patent No. 3,961,863, 6 p, 6 fig, 9 ref; Official Gazette of the United States Patent Office, Vol 947, No 2, p 689-690, June 8, 1976.

Descriptors: \*Patents, \*Waves(Water), \*Currents(Water), \*Energy transfer, Bodies of water, Hydraulic equipment, Mechanical equipment, \*Pumps, Floats.

A method and apparatus are described for converting the natural surface motion of water into usable energy by utilizing the force magnification properties or mechanical advantage, of leverage in the strut members of a beam or truss structure for efficiently activating a pump. At least one flexible tubular pumping element is supported by floats interconnected by means of a flexible multiplanar beam or truss structure. The pumping action originates from the element being flexed axially by the multiplanar movement of the water acting on the floats. The multiplanar movement of waves and currents reflects a multiplanar truss system by the action of bending moments from flotation, flow resistance and gravity. Preferably at least two parallel disposed pumping elements are utilized in the apparatus, and two or more of these pairs are connected for providing the desired pressure and volume output. The flexible multiplanar truss structure comprises a horizontal system and a vertical system, both of which include lever arm struts having chord segment linkage between strut ends. (Sinha-OEIS)  
W76-13138

**METHOD OF REMOVING MATERIAL FROM A BED OF A BODY OF WATER,**  
For primary bibliographic entry see Field 5G.  
W76-13155

### 8D. Soil Mechanics

**CONTINUING MEASUREMENTS OF A SWELLING CLAY IN A PONDED CUT,**  
Texas Univ. at Austin. Center for Highway Research.  
M. L. Steinberg.  
Available from the National Technical Information Service, Springfield, VA 22161, as PB-242 546, \$4.00 in paper copy, \$3.00 in microfiche. Research Report 118-8, December 1974. 36 p, 26 fig, 6 ref.

Descriptors: \*Ponding, \*Road construction, \*Expansive clays, \*Moisture, Moisture content, Heaving, Roads, Highways, Clays, Soil, Soil water, Soil mechanics, Soil engineering, Soil sealants, Soil stabilization, Lime, Civil engineering, Construction, Paving.

Ponding is a practical method of causing a soil which may heave to do so before a pavement is

placed rather than after. Results of observations of the maintenance problems and pavement conditions were noted and an attempt was made to relate the depths of movement and effectiveness of the ponding with the longer range goal of developing a method for reducing costs of roadway life. It was concluded that if the potential vertical rise seems likely to exceed one inch and the facility merits it, ponding should be set up on cut and fill sections together with sand drains through the zone of instability to get the moisture well into the expansive clay. Also, an evaporative seal of lime, or perhaps emulsion asphalt with wide shoulders and easily drained ditches, seems worthwhile. And finally, flexible asphaltic base and pavement systems seem possibly to function with the least distress and maintenance costs on these expansive clays. (Sims-ISWS) W76-12818

#### VIBRATIONS OF EARTH DAMS.

Akademiya Nauk SSSR, Moscow. Institut Fiziki Zemli.  
Available from the National Technical Information Service, Springfield, VA 22161 as TT-70-57268, \$8.00 in paper copy, \$3.00 in microfiche. Translation TT-70-57268, 1974. 242p. Translation of Koblebaniya Zemlyanykh Plotin. Voprosy Inzhenernoi Seismologii, No. 11. 1967. NSF C466.

Descriptors: \*Dams, \*Earth dams, \*Vibrations, \*Earthquakes, Earthquake engineering, Dam foundations, Dam failure, Foundation failure, Deformation, Seismic waves, Explosions, Equations, Hydraulic structures, Seismic design, Seismic studies, Seismology, Seismic properties, Structures.  
Identifiers: \*USSR.

Many hydraulic structures and a number of big dams are under construction in regions of the USSR prone to strong earthquakes. This collection of 12 papers by USSR authors covered several problems of earth dams caused by the vibrations of earthquakes and nearby explosion blasts. Several papers reported the measurements of vibrations in earth dams. Other papers reported the effects of these vibrations on foundations and bodies of the dams. Spectra of earth vibrations were reported. A final paper summarized the investigations in other countries on the problem of seismic resistance of earth dams. (Sims-ISWS) W76-12823

#### IDENTIFICATION AND NATURE OF DISPERSIVE SOILS.

Soil Conservation Service, Lincoln, Nebr.  
J. L. Sherard, L. P. Dunningan, and R. S. Decker. Journal of the Geotechnical Engineering Division, Proceedings of American Society of Civil Engineers, Vol 102, No. GT4, p 287-301, April 1976. 6 fig, 2 tab, 21 ref.

Descriptors: \*Clays, \*Dams, \*Earth dams, \*Rockfill dams, \*Erosion, \*Soil properties, Colloids, Dispersion, Flocculation, Irrigation, Reservoirs, Seepage, Soil mechanics.  
Identifiers: \*Geotechnical engineering, Piping(Erosion).

Some fine-grained soils, called 'dispersive' soils with higher content of dissolved pore-water sodium than ordinary soils, rapidly erode forming tunnels and deep gullies by a process in which the individual clay particles go into suspension in slow-moving water (colloidal erosion), damaging earth dams, canals, and other structures. Dispersive soils cannot be differentiated from ordinary soils by conventional soil mechanics tests. An investigation in which four different laboratory tests for dispersion were performed on a considerable number of soils of diverse origins and properties has provided improved understanding of the properties of dispersive soils and strengthened identification criteria. High pore-water sodium is confirmed to be the main factor causing a soil to be

dispersive, although there are a few exceptional low sodium dispersive soils. The newly developed pinhole test, in which erosion is measured directly by causing water to flow through a small hole in a compacted specimen, is the most reliable single test. (Bell-Cornell) W76-13170

#### PORE-WATER PRESSURE CHANGES DURING SOIL LIQUIFACTION.

California Univ., Berkeley. Dept. of Civil Engineering.  
H. B. Seed, P. P. Martin, and J. Lysmer. Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 102, No. GT4, p 323-346, April 1976. 16 fig, 3 tab, 18 ref.

Descriptors: \*Earthquakes, \*Pore water, \*Pore pressure, Consolidation, Seepage, Vibration, Evaluation, Hydrostatic pressure, Sands, Analytical techniques, Drainage.  
Identifiers: \*Geotechnical engineering, \*Liquefaction, Sand deposits.

An analytical procedure is presented for evaluating the general characteristics of pore-water pressure buildup and subsequent dissipation in sand deposits both during and following a period of earthquake shaking. It is shown that in layers of fine sand, excess hydrostatic pressures may persist for an hour or more after an earthquake. However, evidence of subsurface liquefaction may not appear at the ground surface until several minutes after the shaking has stopped and the critical conditions at the ground surface may not develop until 10 to 30 minutes after the earthquake. However, for coarse sands and gravels with an impedance of drainage due to the presence of sand seams or layers, pore pressures generated by earthquake shaking may dissipate so rapidly that no detrimental build-up of pore pressure or a condition approaching liquefaction can develop. Improving the drainage capability of a sand deposit may thus provide an effective means of stabilizing a potentially unstable deposit. Analyses of the type described also provide the means for assessing whether subsurface liquefaction will have any serious effects on structures supported near the ground surface. (Bell-Cornell) W76-13171

#### 8E. Rock Mechanics and Geology

##### MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.

Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C. W76-12787

##### MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.

Geological Survey, Denver, Colo.  
For primary bibliographic entry see Field 7C. W76-12789

##### MAP OF ROCK TYPES IN BEDROCK OF ALLEGHENY COUNTY, PENNSYLVANIA.

Geological Survey, Harrisburg, Pa.  
For primary bibliographic entry see Field 7C. W76-12791

#### GROUNDWATER GEOPHYSICS IN SOUTH AFRICA.

Wellfield Services, Johannesburg (South Africa).  
For primary bibliographic entry see Field 4B.

W76-13027

**HOW TO DRILL A USABLE HOLE - PART 2, DESIGNING THE BOTTOMHOLE ASSEMBLY.**  
Drilco, Houston, Tex. Technical Services.  
For primary bibliographic entry see Field 8B. W76-13038

#### 8G. Materials

##### GROUNDWATER GEOPHYSICS IN SOUTH AFRICA.

Wellfield Services, Johannesburg (South Africa).  
For primary bibliographic entry see Field 4B. W76-13027

##### EFFICIENCY-A WORLD OF FANTASY.

Australian Ground-water consultants Ltd., Sandton, Transvaal (South Africa).  
M. W. Bell.  
Journal of the Ground-Water Association of South and South West Africa, Vol. 1, No. 5, p 11-13, July 1976.

Descriptors: \*Specifications, \*Pump testing, \*Groundwater, \*Storage coefficient, \*Yield equation, Boreholes, Water yield, Drawdown, Construction, Design, Aquifers, Water wells, Transmissivity, Permeability, Efficiencies.  
Identifiers: \*Borehole efficiency calculation, Radial flow, Gradient, Recovery, Hydraulic head.

The drilling specification is a document not well understood. In the forefront of the gap of understanding is the borehole efficiency clause. This clause is of immense importance as the efficiency of a pumped well determines the characteristics of the well. Good well design and construction aim to obtain a hydraulically efficient well that will give a required discharge and maintain a long life. Transmissivity, storage coefficient and drawdown are determined by hydraulic analysis, i.e., the pumping test. Efficiency must not change because of the aquifer character. The hydraulic efficiency of a well can be calculated if the hydraulic constants of transmissivity and storage are determined. These constants are determined by pumping a water well of a constant rate and measuring drawdown and/or recovery. A borehole efficiency calculation is based on the practical derivation of aquifer characteristics and it determines the damage created in installing the borehole into the aquifer. Poor drilling techniques can decrease near well permeability and increase well drawdown, and proper well development technique is required to rectify this. (Grobe-NWAW) W76-13028

**'STIFF FOAM' DRILLING.**  
Wellfield Service, Johannesburg (South Africa).  
Div. of Drilling Technical Services Ltd.  
For primary bibliographic entry see Field 8B. W76-13029

**DOWN-THE-HOLE INSURANCE.**  
Plummer and McDannald Co., Galena, Ohio.  
R. B. McDannald.  
Water Well Journal, Vol. 30, No. 9, September, 1976. p. 20-21, 1 fig.

Descriptors: \*Drilling equipment, Boreholes, Wells.  
Identifiers: \*Drilling jars, \*Fishing jars, \*Drilling jars specifications, \*Drilling jar fabrication, Drill string, Stuck drilling tools, Drilling.

A drilling jar consists of two connecting links, called reins, with a pin joint at the upper end and a box joint on the lower. It is placed in the tool string between the socket and drill stem to prevent the bit from sticking. Welded jars are manufactured by forming two steel billets into reins and welding



## Field 8—ENGINEERING WORKS

### Group 8G—Materials

one of the open ends to a pin joint and the other to a box joint. The reins are made of selected, heat-treated alloy steel. The drop and hammer forge weldless process from one piece of alloy steel is a more expensive type of jar construction; however, the heat-treated forgings gives maximum safety and long life. Jars are measured by the diameter over the reins and may be purchased with joint sizes to match the diameters. However, the jar diameter should not exceed the box collar diameter of the selected joint. To insure against the jar opening with each drilling stroke, it is important to drill with a tight line. A slack line will damage the spade ends or fatigue and crack the reins. Fishing jars are the most important fishing tool the driller uses, and should be made of good quality steel and effectively heat-treated. The weight of the stem above the jar is the effective force in jarring loose the stuck tools. The wrist pin should be adjusted to effect a short stroke, which gives better control of the tools while fishing. Fishing jars are of the same construction as drilling jars, with the exception of a much longer stroke. The long stroke allows the fishing stem to hit a heavy jar when jarring up or down, but only one way when jarring on stuck tools. Jars with a 24" or 30" stroke are commonly used in shallow wells. Jars with a 36" stroke are normally used in gas and oil fields. (Grober-NWWA) W76-13032

**WELL CUTTINGS ANALYSIS IN GROUND-WATER RESOURCES EVALUATION**, Arizona Univ., Tucson. Dept. of Soils, Water and Engineering. W. G. Matlock, G. C. A. Morin, and J. E. Posedly. Ground Water, Vol 14, No 5, p 272-277, September-October, 1976. 4 fig, 5 ref.

Descriptors: \*Logging(Recording), \*Data collections, \*Water wells, \*Soil analysis, Subsurface investigations, Drilling, Geologic formations, Sampling, Aquifers, Stratigraphy, Arizona. Identifiers: \*Well cuttings, Tucson(Ariz).

A standardized method for collection and analysis of well cutting samples is of immense aid in determining formation and hydrologic boundaries for the hydrogeologist in the ground-water resources evaluation of certain types of alluvial aquifers. The method standardizes collection procedures which minimize disruption of the drilling process and allows for easier laboratory interpretation. Analysis techniques for soils are adapted to differentiate between the formations encountered. Wet and dry color, particle size analysis, acid reaction, in addition to examination of mineral constituents permits correlation of formation characteristics from wells constructed at different times and by different drillers. (Heiss-NWWA) W76-13036

**TECHNIQUES IN EVALUATING SUITABILITY OF BORROW MATERIAL FOR BEACH NOURISHMENT**, Coastal Engineering Research Center, Fort Belvoir, Va. For primary bibliographic entry see Field 8B. W76-13175

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

### 10C. Secondary Publication And Distribution

**LAND APPLICATION OF WASTEWATER**, (LITERATURE REVIEW), New York State Dept. of Environmental Conservation, Albany. For primary bibliographic entry see Field 5D. W76-12676

**WATER RECLAMATION AND REUSE**, (LITERATURE REVIEW), Municipal Environmental Research Lab., Cincinnati, Ohio. Wastewater Research Div. For primary bibliographic entry see Field 5D. W76-12677

**THERMAL EFFECTS ON AQUATIC ORGANISMS, ANNOTATED BIBLIOGRAPHY OF THE 1974 LITERATURE**, Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5C. W76-12692

**THERMAL EFFECTS**, (LITERATURE REVIEW), Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5C. W76-12703

**PUBLICATIONS: UTAH WATER RESEARCH LABORATORY**, Utah Water Research Lab., Logan. March 1976, 62 p.

Descriptors: \*Reviews, \*Research facilities, Water quality, Aquatic environment, Laboratory tests, On-site investigations, Wastes, Temperature, Toxicity, \*Bibliographies, \*Publications, Documentation.

Over 450 publications are listed in four categories. Project reports are preliminary, continuing, and final reports of projects being studied, developed, and investigated by the staff. Occasional papers are prepared for presentation at a symposium or conference but not published in a proceedings of that symposium. Proceedings are papers presented at symposiums or conferences sponsored entirely or in part by the Utah Water Research Laboratory. Reprints are articles contributed by staff members to magazines and professional journals. (Chilton-ORNL) W76-12730

**EFFECTS OF POLLUTION ON FRESHWATER FISH**, (LITERATURE REVIEW), National Water Quality Lab., Duluth, Minn. For primary bibliographic entry see Field 5C. W76-12735

**THERMAL EFFECTS**, (LITERATURE REVIEW), Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5C. W76-12736

**MICROBIOLOGY - DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES**, (LITERATURE REVIEW), Environmental Research Center, Cincinnati, Ohio. For primary bibliographic entry see Field 5A. W76-12896

**INSTRUMENTATION AND AUTOMATION OF WASTEWATER COLLECTION AND TREATMENT SYSTEMS**, (LITERATURE REVIEW), Municipal Environmental Research Lab., Cincinnati, Ohio. For primary bibliographic entry see Field 5D. W76-12901

**CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES**, (LITERATURE REVIEW), Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences. For primary bibliographic entry see Field 5A. W76-12902

**DISINFECTION**, (LITERATURE REVIEW), Georgia Inst. of Tech. Atlanta. School of Civil Engineering. For primary bibliographic entry see Field 05F. W76-12924

**DETERGENTS**, (LITERATURE REVIEW), Missouri Univ., Columbia. For primary bibliographic entry see Field 05C. W76-12925

**ADMINISTRATION - SYSTEMS ANALYSIS**, (LITERATURE REVIEW), Cornell Univ., Ithaca, N. Y. Dept. of Environmental Engineering. For primary bibliographic entry see Field 05G. W76-12926

**SOLID WASTES AND WATER QUALITY**, (LITERATURE REVIEW), Environmental Protection Agency, Washington, D. C. Wastewater Research Div. For primary bibliographic entry see Field 05E. W76-12933

**CONSERVATION: EESG BIBLIOGRAPHY SERIES:16**, Reading Univ. (England). Dept. of Economics. For primary bibliographic entry see Field 06B. W76-12953

**ENVIRONMENT AND SOCIAL CLASS, EESG BIBLIOGRAPHY SERIES 15**, Bristol Univ. (England). Dept. of Economics. For primary bibliographic entry see Field 06B. W76-12962

**WATER POLLUTION, EESG BIBLIOGRAPHY SERIES: 17**, Newcastle-upon-Tyne (England). Center for Research in Public and Industrial Economics. For primary bibliographic entry see Field 05G. W76-12963

**ATMOSPHERIC AEROSOLS: A LITERATURE SUMMARY OF THEIR PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION**, Old Dominion Univ., Norfolk, Va. School of Sciences. For primary bibliographic entry see Field 05A. W76-12996

**ANNOTATED BIBLIOGRAPHY ON THE GEOLOGIC, HYDRAULIC, AND ENGINEERING ASPECTS OF TIDAL INLETS**, Army Engineer Waterways Experiment Station, Vicksburg, Miss. For primary bibliographic entry see Field 02L. W76-12999

**INDEX TO NATIONAL TOPOGRAPHIC MAPS: 1:250,000-SCALE SERIES**, Geological Survey, Reston, Va. For primary bibliographic entry see Field 07C. W76-13077

**VIRUSES IN WASTE, RENOVATED, AND OTHER WATERS. 1974 LITERATURE ABSTRACTS**, National Environmental Research Center, Cincinnati, Ohio. For primary bibliographic entry see Field 05D. W76-13095

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★U.S. GOVERNMENT PRINTING OFFICE: 1976-240-879/4



